UNITED STATES ARMY AVIATION DIGEST

JULY 1968

Take up our quarrel with the foe:
To you from failing hands we throw
The torch; be yours to hold it high.
If ye break faith with us who die
We shall not sleep, though poppies grow
In Flanders fields.

UNITED STATES ARMY AVIATION DIGEST

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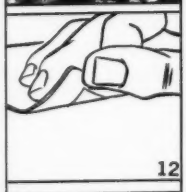
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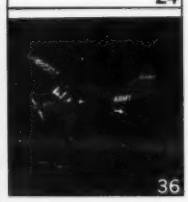
36

JULY 1968 VOLUME 14 NUMBER 7

VIEWS FROM READERS 1
WHY FLIGHT FOLLOW? CPT John H. Hastings 2
MAYDAY — WEATHER, CPT Jerry J. Boyington 6
FIRST AID, CW2 Randy L. Cockrum and CW2 Dale C. Evans 9
SECONDS TO A MIDAIR, CW2 Robert D. Kallay, Jr. 10
GAME'S OVER, CW2 Stephen K. Little 12
THE ARMY CONCEPT TEAM IN VIETNAM (ACTIV), COL J. Elmore Swenson 16
SHOULD WE FLY HELICOPTERS ON INSTRUMENTS? MAJ Richard L. Eakley 19
ROTARY ROULETTE, CW2 Francis D. Thornburg 22
ONE WAY STREET, CWO H. P. Hulen 24
CRANK — HOVER — CRASH! 27
WHEN WAS THE LAST TIME YOU CHECKED THE SWASHPLATE SUPPORT ASSEMBLY? CW2 Frederick S. Minnich 30
CH-37 MOJAVE — WORKHORSE OF KOREA CPT Rush R. Wicker 32
CRASH SENSE 36
OPERATIONS IN SANDY AREAS, MAJ Francis J. Toner 48
HELICOPTER ROTORWASH EFFECTS, E. H. Flinn 50
PEARL'S 59
NEW CHINOOK NONSYMMETRICAL AIRFOILS, Ray Spears 64
ANNUAL WRITING AWARDS Inside Back

ABOUT THE COVER

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The final stanza of John McCrae's "In Flanders Fields" reminds us on Independence Day that the torch of freedom has long been held aloft by a succession of courageous hands

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

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VIEWS FROM READERS

Sir:

Much has been said concerning the supposedly apparent shortcomings inherent in connection with civilian contractor maintenance as applied in this instance to rotary wing aircraft.

Not a day goes by that there is not heard from far and near the rumblings of righteous indignation. Either this man was exceptionally sloppy in his work, or this person failed to do this or the comment most commonly heard, "He just looked at it and wrote it off without even checking it."

These complaints may or may not have a valid foundation but what is more important, they do have a definite effect upon one's confidence of and trust in the aircraft that we out of necessity must fly day in and day out.

This of course would and does have a detrimental effect upon the morale of any unit. To be effective an aviation unit must have confidence in the aircraft they fly. Indiscriminate talk of poor maintenance can only deter from their effectiveness, whether in a TOE unit or in a training environment such as ours.

It is my opinion that the maintenance performed on our aircraft is sound and worthy of defense. Perhaps by relating a personal experience which is rather timely and pertinent to the subject at hand I may in a small way be able to allay some fears and restore a little lost trust.

Not too very long ago I found myself in that uncomfortable situation which will befall those aviators who are not as diligent in maintaining their flight records as they out of necessity should be. Here it was the last day of the fiscal year and I did not as yet have my flight minimums in. Of course, there were extenuating circumstances associated with this embarrassing predicament, but I shall not venture into them at this time.

After much telephoning and running about, arrangements were finally made for me to acquire my needed time by flying with a test pilot as he performed his routine duties. This person was employed by the selfsame civilian organization which services our aircraft. I can only say that I was more than favorably impressed by the professionalism displayed by this test pilot and his mechanic partner who make up the two-man team used for this function. It was gratifying to observe the care and concern exercised by these people in carrying out their duties.

The purpose of these test flights was the tentative release of the aircraft to the flight line after inspections, repairs, etc. The preflights performed by this team amazed me. I had always thought that I pulled a pretty thorough preflight; compared to these guys I was a rank amateur. They checked areas that I had never thought of—they didn't leave a screw unturned. As a matter of fact, four aircraft were turned down in a row for deficiencies that I would never have caught. They were so thorough that I had fears that they were going to run out of aircraft before I had a chance to get my time in and I only needed 40 minutes.

It turned out that we finally flew the fifth aircraft but only after the test pilot requisitioned the services of a technical inspector to clarify a point on proper tolerances.

The test flight itself was no less thorough nor comprehensive. I finally got my flight time in but it was close to midnight when I did.

I came away from there that night with a whole lot of confidence in, and respect for, the people who see to it that our aircraft are safe to fly. This experience allayed what fears I may have had concerning the level of our maintenance. If these men were representative of our civilian aircraft maintenance, and I am sure that they were, I am awfully glad to have them on my team. My confidence was restored that night.

LT Herbert Wilkerson
Dept of Tactics
Ft Rucker, Ala. 36360

• Confidence in the quality of his maintenance support is a necessary part of the aviator's morale. Thank you for sharing this experience with us. —The Editors

Sir:

My thanks to LTC Donald Frandsen for crediting me with "Selling the Exotics in CI Operations" in your January 1968 edition.

In all fairness, I feel I can take credit for organizing and coordinating the first airborne use of the RO-166 Recorder Processor Viewer in a combat zone. However, it was Lieutenant (now Captain) Bill Ebert and SP 4 John Francis who flew the actual "first" mission. With the cooperation of the U. S. advisors to the 25th ARVN Division, artillery was effectively used which in turn led to use of aerial lighting facilities with attack aircraft.

Also, Mr. Jerry Brown, technical representative of the Motorola Corporation, provided invaluable assistance in this development period.

John R. Connelly
150 Larkspur Road
Fairfield, Conn. 06430

Sir:

This letter concerns the "Checkout Duck" article in the Feb '68 issue of Aviation Digest. I beg to differ with the recommendations of the investigation board and reviewing official, and the concurring indorsement of the letter of transmittal.

The board recommended that low level autorotations not be practiced or demonstrated unless the pilot being checked has never successfully com-

Continued on page 35

Why Flight Follow?

It makes good sense, especially in the combat zone

Captain John H. Hastings

PROBABLY VERY few Army aviators who are Vietnam veterans would even consider asking the above question. But with the tremendous influx of young, inexperienced aviators into Army aviation, I'm sure many are asking themselves, "Is flight following really necessary?"

Under the provisions of AR 95-2, all Army aviators are required to flight follow with military airways stations or FAA traffic communications stations under VFR and, of course, under IFR conditions. However, section I, paragraph a, of the same regulation also states: "This regulation is applicable to the operation of all Army aircraft; however, nothing promulgated herein will be interpreted as restricting or impeding the operation of Army aircraft within the combat zone." One may think that this is a way out of the admittedly small effort it takes to flight follow. Let's stop kidding ourselves, it just makes good, plain sense to abide by this procedure, *especially* in the combat zone of Vietnam.

The following true accounts concern three O-1 Bird Dog aviators and their experiences in the Republic of South Vietnam. In that war-torn country, flight following is an absolute necessity — for the lonely O-1 driver especially, for he flies most of his missions by himself with no other aircraft to rely upon.

First we have Lieutenant A's story: "In September 1965, elements of the 173rd Airborne Division, in conjunction with various ARVN units, were conducting a search and destroy operation in the Viet Cong infested iron triangle and part of war zone C area north of Saigon. It was the mission of the O-1 Bird Dog company in the corps area to support this operation in aerial artillery adjustment, visual reconnaissance, and radio relay — both day and night.

"One dark, cloudless night it was my turn to fly the late shift on a routine radio relay and visual recon over the operation area. Everything seemed to be working out smoothly as my observer, an American sergeant, and I took off in my O-1F into the murky sky for a 3 hour mission. On this particular mission I was flying one of the older aircraft that was still equipped with a temperamental VHF radio. These particular radios were known to malfunction at times and this flight was to be no exception.

"Upon climbout from Bien Hoa, I changed VHF frequencies to the flight-following center at Saigon. It was then my VHF decided it needed a much deserved rest, for my efforts to contact Saigon center proved fruitless on either the regular frequency or on 121.5. I tried calling Bien Hoa tower, with the same negative results. It was then that I made the mistake I would regret later. Instead of returning to Bien Hoa for avionics maintenance, I continued to the operation area confident that the problem was only temporary; besides I had my FM radios. Anyway, 'What's so important about flight following?' I said to myself.

"Arriving over the southern boundary of the operation area, I again attempted to contact Saigon center but with the same quiet void meeting me on the receiver. Then I remembered that the center had an FM frequency and I attempted to find the number among the maze of charts I had aboard. Sorry about that; I forgot to bring my frequency card. I had been airborne now about ½ hour with still no flight-following contact. Really nothing much to worry about; I'm still flying and the area seems quiet."

Meanwhile, unknown to Lieutenant A, Saigon center was informing any aircraft flying in the operation area to remain clear of a restricted area southwest of Ben

---

CPT Hastings wrote his article, "Why Flight Follow?" because of his concern over negligent flight following procedures. It is hoped that the accounts he describes will serve to reinforce proper flight following habits.

My unbelieving eyes saw a series of the most fantastic ground explosions I had ever seen and they were coming closer and closer below my aircraft . . . B-52s! We were right over the edge of a B-52 strike. Why didn't anyone warn me?

Cat — the iron triangle.

Back to Lieutenant A: "With still no contact with Saigon center, whom I had all but forgotten, my observer and I were having difficulty raising anyone on the FM frequencies we were to use in contacting the ground units. A blackout visual reconnaissance over the iron triangle at 1,500 feet was also proving of little use because of the complete blackness of the night, so I began a gentle climb to a respectable altitude for better radio communication.

"I was over the northeastern boundary of the iron triangle and in a climbing turn back into the area I had just overflown when bedlam broke loose below and a short distance in front of me. My unbelieving eyes saw a series of the most fantastic ground explosions I had ever seen and they were coming closer and closer below my aircraft. The O-1F began to buffet from the force of the explosions, even at my altitude of over 1,500 feet. I immediately made a sharp 180° turn with full power, turned on all my lights and headed my Bird Dog out of the iron triangle like a frightened pup with his tail between his legs.

"My terrified observer looked up above us (perhaps praying) and saw a series of lights far in the distance. I also looked up and saw three white lights emitting from three apparently large, fast moving aircraft. I looked back at the ground explosions now slightly behind the O-1 and yelled, 'B-52s!' We were right over the edge of a B-52 strike! I turned my aircraft toward the town of Ben Cat, knowing I would be safe from the airstrike if I remained over the town.

"We orbited over Ben Cat and observed the deadly beautiful and fantastic strike from a safe distance. The aircraft still appeared to be buffeting but as soon as I removed my shaking hand from the control stick, the aircraft flew as smooth as glass. When the strike was over I kept angrily saying to myself, 'Why didn't anyone warn me?' "

Meanwhile, back at Saigon center, the controller was informing all aircraft in the operation area that the restriction over the iron triangle had been lifted.

One shudders at the thought of a bomb hitting the aircraft. We do know that if Lieutenant A had established radio contact with Saigon center and had maintained

Why Flight Follow?

proper flight-following procedures, he would have had a more pleasant flight.

Our next aviator we shall call Lieutenant B. Unlike Lieutenant A, this young aviator used flight-following procedures which subsequently led to his rescue in the jungles northeast of Vung Tau, RVN.

Lieutenant B was engaged in a combination administrative and visual reconnasissance flight in his O-1F that afternoon from Bien Hoa southeast to Ham Tan, section headquarters for the ARVN division. Lieutenant B was properly flight following with the division headquarters communication center. He adhered to the proper procedures by reporting over predetermined checkpoints and giving the intended route of flight for the next leg.

After reporting at his last checkpoint, he reported he would be landing at his destination in 25 minutes and that he would be reconning sector L-3 en route. (The entire division area was divided into visual recon sectors for easier reporting procedures.) At approximately 1700 hours at 7 minutes from destination, Lieutenant B's aircraft oil pressure began to drop rapidly. Lieutenant B began to look quickly for a clearing to put the Bird Dog into when all oil pressure was lost and the engine began to seize. Although he was too low in altitude to contact division headquarters flight-following, he was able to contact his destination radio, Ham Tan: "Ham Tan, this is Lieutenant B on an east heading, 5 miles west of your position, have lost power and am going down. Over!"

The radio controller immediately contacted division headquarters via phone and stated, "An O-1F has just gone down 5 miles east of Ham Tan." In less than 10 minutes aircraft from division headquarters, 25 miles away, were airborne and the search was begun in the area east of Ham Tan. Thanks to Lieutenant B's flight-following procedures, the error in the radio operator's message was soon discovered and the search was switched to the area west of Ham Tan. In less than half an hour, almost at dusk, Lieutenant B and his observer were located by an Army O-1F and picked up by helicopter.

Had Lieutenant B not been properly flight following, the search may have lasted into the night with the possibility of locating the downed personnel and aircraft more remote by the hour.

The story of Lieutenant C is an excellent example of proper night flight-following procedures. Lieutenant C attributes his being alive today to a little luck and a lot of faith in this necessary reporting procedure.

It was another one of those dark, no-moon nights in zone D, northeast of Saigon and north of Lieutenant C's home airfield, Xuan Loc. Lieutenant C's mission was to fly his tiny O-1F on a visual reconnaissance up the Dong Nai River, which borders zone D. There had been recent reports of Viet Cong night river crossings from zone D to the jungle area just north of Xuan Loc, and Lieutenant C's platoon had been flying all-night recon missions over the area for the past week.

Before takeoff, Lieutenant C, following established platoon procedures for night flights, reported to the communications room and

In less than half an hour they were located and rescued

outlined on a large wall map his exact route of flight and reporting points. This was then shown to the radio operator to whom he would be reporting. At takeoff time of 2300, Lieutenant C and his Special Forces observer climbed into their Bird Dog and departed.

Throughout the flight Lieutenant C correctly reported his position over his checkpoints that were planned to be about 20 minutes apart. At approximately 2335 he called control: "Amazing Control, this is Lieutenant C over checkpoint D, returning on a 270° heading to the river along flight planned route. Over." That was the last radio call Lieutenant C was to make, for in a very short time his aircraft crashed into the dense jungle of zone D.

Lieutenant C's story: "Having reached the Dong Nai, my observer and I noticed lights on the northern side of the river. I dropped a flare from approximately 2,500 feet and circled down for a closer look. I was in a slight bank when the flare flickered out. I immediately felt a sharp concussion or jolt, added power, then another jolt — then began falling, and blacked out."

Back at the communications center at Xuan Loc, the radio operator, not having radio contact with Lieutenant C in over 25 minutes followed established procedures by continually trying to contact the aviator — with no results. Ten minutes later, the radio operator phoned the platoon leader of the missing Lieutenant C. In a short time, a search was begun which was to eventually last through the night and was to involve Army fixed and rotary wing aircraft and the division Air Force forward air controllers and an Air Force flare ship. Because of Lieutenant C's flight-following procedures, the search was limited to the area along the Dong Nai River west of checkpoint D.

He spotted the lieutenant trudging through the jungle

At daybreak, an O-1 pilot spotted a small pen flare and then saw a dazed Lieutenant C trudging through the jungle in his stocking feet. Upon Lieutenant C's hazy directions, the aircraft, barely visible through the dense jungle growth, was spotted and the search for the two Americans was over. As a result of Lieutenant C's correct flight-following procedures and the valiant efforts of those personnel engaged in the search and rescue operation, the mission ended successfully. Need I say more?

As you can readily see, flight following actually serves two purposes. First, it enables a ground station to know at all times the location of an airborne aviator and, second, it is an excellent means of communicating special reports to the aviator. Each of us has a personal responsibility to maintain and improve upon these procedures. Is flight following really necessary? You're darn right it is!

MAYDAY--WEATHER

Captain Jerry J. Boyington

Several times the pilot was forced to climb rapidly or veer sharply to avoid the many steep ridgelines

WHAT BEGAN as a routine combat support flight from Qui Nhon to Saigon and return terminated as a very realistic nightmare for four crewmembers of a Huey gunship.

The four airmen departed Qui Nhon for Tan Son Nhut with intermediate stops at Ban Me Thuot and Gia Nghia. They had received instructions to fly their new UH-1B gunship to Tan Son Nhut, have the M-16 gun system mounted on the aircraft, and return to their unit as soon as possible.

The monsoon season was drawing to a close along the coastal regions of the country, leaving towering cumulus along the mountains which extend down the coast. Since their flight through this part of the country was made during the morning daylight hours, little difficulty was experienced in navigating through these scattered layers. Breaking out over the plateau region, they found the weather to be excellent and made their refueling stops at Ban Me Thuot and Gia Nghia as planned. They arrived at Tan Son Nhut that afternoon.

Their work in readying the gunship for combat operations was conducted with a sense of urgency. Each crewman remembered the final instructions he had received from the gun platoon leader and the operations officer: every available gunship was needed for the coming combat assault operations. It was hinted that these missions would be conducted with the South Korean Tiger Division and would start in a matter of days. The Koreans had gained an impressive reputation as tough and skillful guerrilla fighters since arriving in Vietnam. The four airmen looked forward to the coming operations with these elite troops.

By afternoon of the second day of their mission, the new gunship was ready for combat. The crewchief and door gunner had seated seven 2.75" rockets in each of her two new pods. Her dual-mounted machineguns stood loaded and poised. With their work at Tan Son Nhut completed, there remained only the return flight to Qui Nhon.

The anxious crewmen, with their now combat ready gunship, lifted off Tan Son Nhut in midafternoon. The gunship, heavily loaded with armament, crew baggage and fuel, climbed slowly to altitude. A first refueling stop would be made at Gia Nghia with a second stop at Ban Me Thuot. The skies were clear and sunny with promise of an unhindered, pleasant flight.

Their refueling stop at Gia Nghia required more time than planned, since fuel drums had to be rolled out to the aircraft and the fuel pumped in manually. No time was wasted, however, and the aircraft departed for Ban Me Thuot.

On arriving at Ban Me Thuot at approximately 1600 hours, the crew refueled the gunship and prepared for the final leg to Qui Nhon. The crew had worked on the gunship during the noon hours at Tan Son Nhut and had not eaten since morning. The pilot arranged for them to eat the evening meal at the aviation unit mess on the airfield. The sun was still high in the sky over the highlands and the captain felt certain the final flight to Qui Nhon would be a routine one.

After the crew had eaten, they boarded the gunship and lifted off from the airstrip. The aircraft was set up on the return heading at altitude. Not a cloud was in sight. Pyramid Control was providing flight following service to Qui Nhon. Their flight had indeed been a routine one up to this point.

Approximately 30 minutes after takeoff and flying on a direct magnetic heading, they arrived at the first group of mountains which lay midway on their flight path. Here the weather began to change rapidly. Instead of sunny skies, thunderstorms and cumulus buildup began to appear as an impenetrable wall across the horizon. Both aviators viewed this activity with increasing concern.

They had reached a point on their flight where a return to Ban Me Thuot would require more time than proceeding on to Qui Nhon. Should they elect to abort this final leg and attempt a return, their remaining fuel would be marginal. Then too, the gunship was heavily loaded and burning fuel rapidly. To continue their flight, they would be forced to fly at low

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CPT Boyington relates how he and three other airmen overcame what appeared for a while to be a disastrous situation when they encountered weather while on a routine flight in the Republic of Vietnam. It is his hope that others may gain from his frightening experience.

Mayday — Weather

altitudes under the weather with blackout conditions. Going on top was impossible due to towering cumulus. They would also be flying over terrain long under Viet Cong control. To add to their dilemma, darkness was settling fast over the mountains due to the thickening cloud layers.

Discussing their situation with the crew, the pilot made the decision to continue on their course under the low ceilings blacked out. All gun switches were placed in the "hot" position and the crewchief and door gunner took their places at the ready.

As if to welcome the helpless aircraft and the crew, Mother Weather opened her misty, cloud-shrouded arms and allowed them to pass over the first group of mountains. And in her caressing but deadly embrace, she closed all avenues of escape to the now desperate crew.

Minutes began to pass like hours to the four anxious airmen. Each small valley and draw offered only seconds of relief from the dark, soft, rolling mass of endlessness overhead. Each passing minute brought even more darkness. The pilot was finding it extremely difficult to navigate. Visibility was further restricted by a light but constant drizzle.

Their flight was being made at extremely low and dangerous altitudes. Several times the pilot was forced to climb rapidly or veer sharply to miss steep ridgelines, hilltops or tall trees. The ceiling was settling fast on the ridges and mountainsides, making flight over them impossible without going IFR. This condition forced the pilot to disregard his planned course completely in order to fly down valleys and draws.

Small campfires began to appear in the rain forest below. There was little doubt to whom they belonged. "Charlie" was taking advantage of the monsoon ceilings to exist in complete safety. Their visible presence tended only to increase the anxiety of the desperate airmen.

The radio magnetic compass was unreliable due to the terrain, and their fuel supply was getting critical. Further flight was becoming impossible without crashing into a darkened mountainside. No radio contact could be made with any station or aircraft. The pilot had just made a 180° turn out of the soup for the third time. Airspeed was down to 40 knots.

After having a frank discussion with his crew, the pilot made the decision to attempt to land in the first place available and take their chances on the ground until the weather and visibility cleared sufficiently to allow them to get out of the valley in which they were now trapped.

There were moments of silence as the pilot turned the aircraft up the darkened valley in the direction of Qui Nhon. Moments of quiet resignation were felt as all odds appeared against them. Suddenly within seconds, two things happened which raised spirits from the depths of gloom to lofty pinnacles. A voice cut sharp and clear over the UHF radio. "Peacock Control, this is Mingo 79." An aircraft high over the highlands was calling Pleiku flight following service.

In seconds the UH-1B pilot had radio contact with the welcomed voice from the seemingly outside world. "Mingo 79, this is Army helicopter —. I'm in trouble. We are approximately 25 miles southwest of Qui Nhon in the mountains and pinned down by weather. We are unable to climb out and about to start on 20-minute reserve fuel. Wait one, Mingo 79. I just spotted a light through the clouds. Stand by, I'm going to make an attempt to break through."

"Roger, helicopter —. We will orbit and wait you out," came the reply from the distant aircraft.

While talking to Mingo 79, the gunship pilot had observed a small light blinking through a momentary opening in the clouds over the mountainside, in the direction of Qui Nhon. He had set the aircraft on a magnetic heading in this direction and was beginning a slow climb at 60 knots.

It took only seconds to enter the dark, rolling mass of clouds but the minutes that followed seemed like hours to the silent, apprehensive airmen. There were only damp darkness and the steady drone of the engine. Tension lingered in the cockpit like static electricity. Then a hole appeared as if a huge hand had reached down through the clouds and withdrawn, leaving a small opening. And down through this opening the crew again saw, for a brief moment, the small light blinking in the darkness. Reacting instantly, the pilot placed the aircraft into a slow descent on a heading toward the now invisible light.

Their descent broke them out at approximately 200 feet. The small light from the farm house again blinked its welcome to the exhausted but elated airmen. Now they flew over terrain familiar to all four. They recognized the small river which ran beside the farm as one which passed near their base camp after winding down through the mountains. This placed them approximately 15 minutes from the airfield. A final call was made to Mingo 79. Flight following was closed through Peacock Control.

The fuel warning light which flashed on in the darkened cockpit served as a final warning to four airmen who had felt the embrace of Mother Weather in the Republic of Vietnam.

-Aid First-Aid First-Aid First-A

CW2 Randy L. Cockrum and CW2 Dale C. Evans

AIRCRAFT ACCIDENTS often take place in remote areas and perhaps only one of those aboard may be able to give first aid that could mean the difference between life and death.

Because doing the wrong thing may often cause more harm than doing nothing at all, every aviator should have at least a basic understanding of the principles of first aid.

External bleeding can most effectively be stopped by applying a compression bandage over the wound. This can be improvised by applying a thick wad of clean cloth right over the bleeding area, making sure that sufficient pressure is exerted to stop the bleeding. Elastic bandages work well for this purpose.

Bandages should be wrapped just tight enough to stop the bleeding, but not so tight as to cut off circulation. If all circulation is cut off, the tissue beyond the bandage dies in about a half-hour and gangrene can set in. It is best to avoid using a tourniquet. It can cause certain complications and is unnecessary since the continuous pressure of a bandage usually will control external bleeding.

Internal bleeding is much more difficult to stop and normally requires surgery. Usually it cannot be detected in the field.

Wrap an injured person in blankets or keep him warm some other way. To minimize the possibility of shock, loosen tight clothing and lay the injured party on his back. Also try to keep the patient still to minimize possible internal bleeding.

Fractures often occur during aircraft accidents. The immediate need here is to keep bony fragments immobile to prevent sharp edges from cutting into vital tissues, blood vessels, and nerves.

Arm and leg fractures can be readily immobilized by using splints made from boards, pipes, straight sticks, and other straight rigid articles of appropriate size. Two splints are better than one. Bind the fractured limb to the splints with two strips of cloth or belts on both sides of the fracture to ensure immobilization.

Bones that are fractured in several places present more difficult problems. Fractured ribs can sometimes be splinted by wrapping the chest firmly with strips of cloth. Elastic bandages are also useful. However, when there are free segments of ribs, such as when a rib is broken in several places, be careful not to puncture the lungs or other vital organs.

Accidents are frequently accompanied by fire. Fires can, and very often do, cause asphyxiation and severe burns.

Asphyxiation is caused both by a fire that consumes the available oxygen in the cabin and by carbon monoxide poisoning. If breathing stops, artificial respiration may be used to stimulate it. Mouth-to-mouth breathing is the preferred method. It is the most effective, requires the least effort, and minimizes damage from broken bones.

If water has entered the lungs, as during a water crash, begin immediate mouth-to-mouth respiration. Make very sure there are no broken bones. Broken ribs can puncture the lungs, and other broken bones can cut into nerves and blood vessels during the motion required in the older method.

In mouth-to-mouth respiration, you should compress both nostrils of the patient, draw his chin up to extend his neck, cover his mouth with your mouth and exhale forcibly, blowing air through the air passages into the patient's lungs. This is repeated about 12-18 times per minute until the patient can resume normal breathing.

Severe burns cause both pain and shock. Although the pain can be minimized by isolating the burned area from surrounding air, the practice of putting a liquid or an ointment on the severe burn is not recommended. The risk of septic contamination far outweighs any benefit from such pain relief. If it will be several hours before a patient can be treated by a physician, it would be better to administer pain medication by mouth. Ointments can be used on first degree burns where no blister is formed.

These are only a few of the first-aid procedures you need to know for use when someone is hurt. This is not a complete list, but perhaps it will help stimulate increased interest in the subject. After all, the chances are ever with us of encountering a severe injury far removed from professional help.

Warrant Officers Cockrum and Evans offer this review of first aid which can mean the difference between life and death. They chose this topic because, while all aviators have had first aid training, the knowledge gained can become rusty through lack of review or use.

Seconds To A Midair

CW2 Robert D. Kallay, Jr.

IN AUGUST OF 1966, while I was with the 1st Cavalry Division in the central highlands, our company was sent to the Turkey Farm to support operations along the Cambodian border. In accordance with company procedure, there was an operational briefing every morning at 0600 to assign us to various missions. I was assigned to a two ship mission hauling supplies to units up along the Cambodian border. Since I had only been in-country about a month, I filled the slot of copilot of the second ship.

During this time of the year, the weather was often so bad that there was usually a 1½ to 2 hour weather hold. At 0730 of this particular day, the weather finally began to lift enough that the ships could take off. We started hauling the supplies at low level, but as the day wore on the weather improved. By noon the ceiling was about 5,000 feet overcast. This lasted until about 1700. Then, as always happens in the central highlands around mid-August, the weather started coming down again.

We had finished the last supply run about 1830 and decided to head for home. Our fuel supply was getting a little on the low side, so the flight leader decided to stop at the Oasis, a camp about halfway between the Turkey Farm and the Cambodian border where we were working. By the time we had refueled and were back in the air it was 1930, and the ceiling was down to about 1,500 scattered to broken with 1½ miles visibility and light rain.

Since there were a few mountains above 1,500 feet between us and our destination, the flight leader decided to climb above the clouds and go back at a higher and safer altitude. So, headed in the general direction of the Turkey Farm, we both started to climb. The weather we encountered while climbing did not show much change, so at 5,500 we decided to level off. The clouds at this level were a little more scattered than broken and it was evident that going higher would not prove beneficial.

At 5,500 feet, we did have terrain clearance from anything in our area and general direction of flight. However, our situation now was one which most aviators try to avoid: flying in and out of the clouds, especially at night during a light rain. When the pilot comes out of a cloud, he normally tries to go back to flying VFR, but there usually isn't any horizon to use as a reference. This is especially true in Vietnam where you don't have the large cities to light up the sky at night.

Since this was a two ship mission, we had tried to maintain some sort of formation. When it became evident that we would be going into clouds, we, the second ship, dropped back a half a mile or so from the first ship, but still maintained a trail formation — sort of like a baby duck following its mother. Being relatively new in-country myself and the pilot having been in-country only 4 months or so, and *both* of us being very new in the area of operation, we weren't about to lose the lead ship. We watched him like a hawk.

Even though we had placed our trust in the lead ship, we still decided to do something on our own. An Air Force base near the Turkey Farm had a nondirectional radio beacon. So just to cover ourselves in case we lost the lead ship we tuned it in on the ADF. When the needle pointed toward the station, it became evident that rather than flying toward the station, we were flying 90° away from it.

Needless to say, our faith in the lead ship was a little shaken. I called the lead ship and asked if their ADF was operational. They said that it was and that they were then making a 90° turn to the right.

At the time of this transmission we were to the right rear of the lead ship. The only lights showing were his three white formation lights. The navigation lights and the rotating beacon were both inoperative. From our position we were able to see two lights in the lead aircraft, his tail light and his right formation light. This doesn't provide a very good visual reference as to the actual position of the aircraft. About the only thing

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CW2 Kallay's article, "Seconds To A Midair," is based on a true account of a near midair crash while formation flying in weather. He is currently stationed at Ft Rucker.

that it does tell you is that the aircraft is in front of you.

At the time the lead ship reported turning 90° to the right, it went into a cloud and we lost sight of it. We maintained our heading in the same general direction, hoping that when it cleared the cloud we would catch sight of the aircraft again.

We didn't have long to wait. About 15 seconds later we saw the lead ship's two white lights again. They were still in the same position. It didn't look like the ship had turned, so we continued to fly towards the lights. About 20 seconds after we saw the lights again, the lead ship loomed in front of us. It was heading toward us at about a 45° angle to our front.

I am not really sure what action the pilot of our ship took to avoid a collision; in fact, I don't think he is either. At a time like that instinctive reactions seem to prevail. Through the sensations I felt and the fact that we didn't have a midair, I can venture a pretty good guess as to what happened. We both must have realized the situation at the same time, because a split second after I saw the ship to our front I felt myself being pushed into the seat and against my side. Our pilot must have pulled the cyclic hard to the left rear. The pilot of the other ship must have broken to the right. Why we didn't break right also, I'll never know. It would seem to have been the safest way to go, but believe me I'm very satisfied with the results.

The rest of the flight was rather an anticlimax. We decided to go the rest of the way separately. The lead ship went on ahead, while we circled for 4 to 5 minutes to get separation. Then we took up a heading toward the radio beacon. At our destination the holes were very large, and by using the lights of the city of Pleiku we managed to get down low-level and follow a road to the Turkey Farm.

Moral? Do your homework! The best sources of information are friends and flips. Familiarize yourself with available facilities when operating in new areas

When both aircraft got on the ground, the crews still rather shaken from the closeness of the midair, we all got together and tried to figure out exactly what had happened. Some of the conclusions we reached showed that from the Oasis, where we refueled, until we landed almost every decision we had made was bringing us a little closer to an accident.

First of all, since we wanted to fly back VFR it was very poor judgment that we climbed to 5,500 feet and attempted to go back in and out of the clouds. It is basic that a pilot should fly either VFR or IFR, but should never attempt to mix the two. Before climbing, a call to the Metro weather station in the area would have told us the type of weather that we could expect at altitude and just how high we would have had to go to clear the clouds.

Second, after the decision had been made to go back at 5,500 feet, in and out of the clouds, no attempt should have been made to remain in formation. Both aircraft should have proceeded back separately, allowing enough separation that we wouldn't have gotten near each other.

Having made the decision to stay in formation, it should have been a much closer one. At half a mile or so the second ship can't really discern the action of the lead ship. Had we been closer, I think we would have seen the problem that was developing a lot sooner. The pilot of the lead ship, in his attempt to remain VFR and turn 90° to the right, attempted to level the aircraft when he went into the cloud, got spatially disoriented and did a 180 to the left. This explains why when we saw him again it didn't look like he had turned. Instead of going away from us he was coming toward us. After we got on the ground, we discovered that the Air Force base near the Turkey Farm had radar available. All we had to do was call and ask for their assistance. This brings up a good point about knowing the facilities that can be used.

The third and final mistake was atempting to fly at night with only three small formation lights showing on the lead ship. In Vietnam night flights aren't always planned; quite often they just happen.

Lessons can be learned from our experience. A thorough preflight of the aircraft to include the lights, even if it is supposed to be only a daylight flight, and checking all instruments to see that they do operate, in case IFR weather is encountered, should be accomplished at the beginning of the first flight of the day. Also, a complete understanding of the navigational aids and services available to the aviator and how to use them should be basic knowledge to all persons flying in Vietnam.

Game's Over

Smedly's trouble was that he flew like he played poker. He was good at figuring odds, but who wants to fly on percentages

CW2 Stephen K. Little

CW2 SMEDLY leaned back in his wood chair, opening and closing his outstretched hands in a good stretch. Subconsciously he took note of the creaking sound of the old chair and decided to rock forward before the rear legs failed from the strain. He repositioned himself in the chair and focused his gaze onto the poker table and the five new cards that were being dealt to him.

It had sure been a long day. He had arisen early to make a 0600 takeoff with his first student. He had finished flying at 1130 and had presented 2 hours of platform instruction that afternoon. Now here he was shortly after midnight playing a long game of five card draw.

He stretched again as he thought about the last 4 hours of poker. Although he was tired, he also enjoyed the confident feeling he had when winning. Yes, he had been taking the boys to the cleaners and there was no indication that his luck would change now.

Smedly leaned forward and sorted his cards, placing them one on top of the other until he had all five cards stacked on the table. He then picked up the stack and

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CW2 Little's experience as an instructor pilot with the Gunnery Training Branch, Department of Tactics, Ft Rucker, Ala., prompted him to write his fictitious article, "Game's Over." He has re-entered civilian life and lives in California.

glanced at the first card. It turned out to be a four of clubs, which was nothing to get excited about. He then proceeded to thumb through the other four cards and recorded their worth as they came into view. He came up with a six of hearts, a king of hearts, a five of diamonds, and a seven of spades.

Four cards to a straight wasn't bad at all. He could fill it out on either end, so the odds of his hitting were pretty fair. Now all that was needed was an indication of his two opponents' strength. Letting the cards drop slightly from in front of his eyes, he glanced over them to the player on his left.

Smedly's glance found CW2 Tweed studying his cards with great care. Smedly and Tweed had been stationed together for a long time, and he had a good deal of respect for Tweed's skill both in the air and at the poker table. Smedly knew that Tweed was a steady and cunning player who could make the average poker player hesitate to play out a good hand. However, Smedly also knew that Tweed had one basic fault which only a man who had played with him a great deal would recognize. It seemed that every time Tweed was dealt a good hand, the thought of it would cause a very slight twitch in his left eye. Smedly looked for this twitch now and it did not exist.

Smedly's eyes then shifted to the right and came to rest on Captain Spock. Spock's eyes held the apprehensive look of a man who really doesn't know what he has in his hand. The captain was Smedly's flight leader, a very vigorous, intelligent, and perceptive commander. On the other hand Smedly knew that when it came to poker, Captain Spock was not the best. This fault annoyed Smedly because it made it impossible for him to read Captain Spock's face or his patterns of play. The captain had dealt the hand, so it was up to Smedly to open. He switched his attention from Spock back to his own cards.

His stomach sagged as he saw the queen of hearts

After careful thought, Smedly decided that a moderate bet was in order so that he would have a better indication of the power of the board. He placed two $1 bills on the table and leaned back in his chair to study the reactions of his opponents.

Tweed, his poker face still fixed, called the bet with no hesitation. Captain Spock, still with the apprehensive look on his face, hesitated for an instant, then with a sigh contributed his $2 to the pot. Smedly had hoped that Spock would have folded. The man was just too unpredictable. However, no apparent power was on the board yet, and Smedly looked forward to the draw with the impatient feeling he always got when he was trying to pull one out of the bag.

Captain Spock picked up the deck of cards and glanced at Smedly. Depositing the king of hearts, Smedly called for the lid. The captain flipped one card, face down, from the deck over to Smedly's portion of the table. Smedly didn't look at the card but focused his attention on Tweed, who was in the process of throwing away two cards. Spock dealt two new cards in Tweed's direction then clumsily discarded three of his own cards and peeled the substitutes from the deck.

Smedly shifted his eyes back to the lone card on the table before him, reached down with his right hand, thumbed it twice in the lower lefthand corner, and slowly retrieved it. His stomach sagged as he saw the queen of hearts facing him.

DON'T STACK THE DECK AGAINST YOURSELF

So he had failed to fill out his straight, and immediately his mind began to work on solutions to the problem. He knew that both opponents most likely had him beat, so the only alternatives were to fold or try a bluff. Bluff, that was it. The thought began to intrigue him. He pondered Tweed's moves during the playing of the hand.

Tweed had not seemed too proud of his hand on the first bet. Also he had drawn two cards to fill out his hand. Being a dedicated poker player, Smedly had studied Hoyle and knew that the odds were 1 in 47 that Tweed would have more than a pair in the first five cards dealt from a 52 card deck. He also knew that the odds were 1 in 12 of Tweed making three of a kind after a two card draw. He realized that Tweed knew that he had been trying to fill out a straight; and there was a good chance that Tweed could be made to think that Smedly had made it and decide to fold. Smedly had bluffed twice before that evening and was quite sure Tweed knew it. Therefore, the odds were good that Tweed would not think Smedly a big enough fool to try it again and thus take him at the face value of his bet.

Smedly's mind was racing and all his thoughts were beginning to jumble around. He leaned back in his chair, faced the ceiling, and closed his eyes. He could feel the strain of a sleepy mind trying to sort thoughts at its normal rate. He groaned to himself as he thought about how he would feel at six in the morning with his not too adept student. As Smedly pondered the next morning's work he failed to notice the slight twitching in the left eye of the man on his left.

Smedly's attention was brought back to the game by the disgusted groan of Captain Spock as he tossed his cards onto the table. Picking up two $10 bills from the pile in front of him, Smedly laid them in the middle of the table. He had learned that the best way to run a bluff was to place your bet with a noncommittal air, but also to let just a little confidence show, as if not intended. Smedly looked up and met Tweed's gaze — and then he saw it.

Tweed, his left eye twitching ever so slightly, placed two $20 bills and one $10 on top of Smedly's bet and leaned back in his chair.

Smedly felt awfully tired and a little sick to his stomach. It was time to call it a day. There would be other nights of poker — and he wouldn't make the same mistake twice. He got up from the table, said goodnight, and headed for home and bed.

CW2 Smedly could feel his jaw muscles tighten as he yawned then stretched in the left seat of the UH-1C helicopter. It had been a long morning of flying in and out of confined areas with his first two students, and now it was two down and one to go. He glanced out at the bright morning with its cloudless sky and smooth air. He took note of the familiar landmarks below and knew that they were a little over halfway to the first confined area. He yawned again and shifted his gaze to Candidate Slow.

Candidate Slow had just 4 weeks to go in flight school. Smedly chuckled to himself as he thought about how Slow's name described the speed with which he employed air sense. It wasn't that the boy couldn't fly, because he did have a good control touch. The problem was that if he was put in an unusual situation it took him 10 minutes to come to a decision as to what to do about it. He had therefore decided that today was the day to give the student a real lesson in air sense.

Smedly switched his attention once again to the ground and saw that they were just about over the first confined area. He leaned forward in his seat and indicated to WOC Slow that he wanted to make an approach to the area. Smedly noticed the telltale apprehensive look on Slow's face, and decided to put him to the test.

The best way to start the student thinking was to let him make a mistake and then point it out to him. This was not a new technique to Smedly. As a matter of fact he had used it twice before that morning and had found it to be quite effective.

His first student, Candidate Best, had been making some very steep turns low to the ground — a dangerous practice which Smedly had

told Best many times not to do. So when he had started to do one this morning, Smedly had allowed him to continue. After the student had obtained a 60° bank, Smedly had placed his left hand on the throttle and collective and yelled to Best that they had just had an engine failure. The WOC froze on the controls and Smedly could see the fear and confusion in his eyes. WOC Best had learned his lesson well.

The thought of having an actual engine failure during this maneuver had crossed Smedly's mind before its execution, but he had figured that he could only be in the hazardous position for about 10 seconds and therefore the odds were all against it. No further thought on the subject had entered his mind. Smedly yawned again and shifted his attention back to WOC Slow, who was now starting his descent onto base leg to the confined area.

Smedly groaned to himself as he saw they were much too high and were sure to overshoot the area. It would be interesting to see if Slow would make a go-around or still try to make it into the area. Smedly got his answer quickly, for WOC Slow pushed down on the collective pitch and added additional aft pressure on the cyclic to slow forward progress. As the helicopter descended toward the area at an excessive approach angle, Smedly thought about the poker game the night before and what a loser that last draw hand had been — and what a loser he had in the right seat. The only thing he failed to think about was the twitching of the engine oil pressure gauge and the rising engine oil temperature.

The helicopter was now descending at a rate almost equal to autorotation. As the machine passed through 100 feet absolute, Smedly decided to take over the controls and recover from the now almost vertical descent. Smedly reflected on his good teaching technique and knew that WOC Slow had probably learned his lesson well. With confidence and deftness, Smedly took over the controls and began to pull in the power required for recovery.

He would have continued to ponder his teaching ability if it hadn't been for a very annoying sound that was wailing in his ears. Smedly's heart sagged as he saw the engine oil pressure gauge fall to zero. As the rotor rpm passed through 235 on its way to oblivion, all Smedly could think of was that he was very tired and wished he were home in bed. Those were Smedly's last thoughts as a tree limb cut its way through the cockpit.

The trouble with Smedly was that he flew helicopters like he played poker. It is true that he had a good mind for figuring the odds, but who wants to fly on percentages? Flying is a very exacting business that requires one's fullest attention at all times. Smedly was playing with a stacked deck from the word go. First of all he was sleepy and had a hard time concentrating. Second, he made a serious mistake in calculating the chances of an engine failure.

Today wasn't the first time he had placed himself in a hazardous position for 10 seconds. As a matter of fact he had done it 300 times that year, which gave him a total of 50 minutes flying time in unsafe attitudes. This doesn't exactly improve the odds.

Smedly's teaching technique wasn't all wrong. We all know that learning by example is one of the most effective ways for a human to obtain knowledge. On the other hand we also know that too much of anything can be fatal, whether it be wine, women, and song, or reckless flying. Let's take a look at some possible reactions that might be encountered by the student being put through a hairy example and see how effective it really is.

First of all the student is almost sure to experience fear. Now, one of the basic fundamentals of flight instructing is to never induce fear into the student. Teach him to respect his element, yes, but to fear it, never. If there are enough of these examples the student may, through fear, begin to lose confidence in his instructor, or worse yet he may begin to lose confidence in himself. Of course if this happens it is necessary to start all over again with the student and far more has been lost than gained.

Smedly should have found a way to teach by example while still maintaining a safety factor, thus preventing the possible jeopardizing of both aircraft safety and student confidence. So then we ask ourselves whether or not this is possible. The answer is yes.

Smedly could have simulated the same unsafe attitude to the student at altitude by referring him to the altimeter and showing him the height required to recover. This way he would have had the time to enter an effective autorotation and make a safe area. Also, the fear element would have been eliminated. Both the atmosphere for learning and the safety factor would have been greatly improved.

What all this amounts to is this: First of all, if you're going to teach by example then do so with an adequate margin of safety. Don't stack the deck against yourself by a lack of sleep or by trying to calculate the reliability of the machine you are flying. Remember that the stakes are your life and the lives of anyone else riding with you. As the old axiom goes: No careful, well trained, competent pilot will ever be caught in a position from which a reasonably safe emergency landing cannot be made. Unlike poker, there are no second chances in the flying game.

The Army Concept Team In Vietnam (ACTIV)

From combat evaluations of the HueyCobra and the CH-54 to the Commando armored car and RF mine detectors, ACTIV continues to enhance the combat effectiveness of military elements in the environment of Vietnam

Colonel J. Elmore Swenson

THE ARMY CONCEPT Team In Vietnam (ACTIV) recounts a proud record of accomplishments in contributing to the ever-changing nature of and the methods applied to winning the conflict in Vietnam.

Activated on 6 November 1962, ACTIV has consistently played a quiet but effective role in improving U. S. Army capabilities to fight Charlie on his own terms.

ACTIV has never professed to be the sole "think factory" where new and revolutionary ideas are born. On the contrary, ACTIV projects are generated from many sources. U. S. Army Vietnam, Assistant Chief of Staff for Force Development, U. S. Army Combat Developments Command, U. S. Army Artillery and Missile Center, and personnel within ACTIV may note the need for an evaluation or study. Of course, the greatest single source of materiel evaluation is the USARV Procedures for Expediting Non-Standard Urgent Requirements for Equipment (ENSURE) program.

The operations and administrative elements of ACTIV provide the normal support to the three evaluation divisions. The Army Aviation, Ground Combat, and Logistics/Electronics Divisions are responsible for planning, programming, supervising and conducting evaluations and studies within their functional areas. These evaluations range from the more extensive conceptual or organization and doctrine type to the simplest materiel evaluations requiring the unique environment of Vietnam.

Project officers and contract scientific personnel within ACTIV operate on a balanced team principle. This requires that for each ACTIV project, the mix of soldier/scientist skills necessary to evaluate effectively the equipment/concept are selected as early as possible in the project planning cycle. This is accomplished through

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COL Swenson is the commanding officer of the U. S. Army Concept Team in Vietnam.

the design of an evaluation plan. When this plan is approved by Headquarters, U. S. Army Vietnam, and the evaluation units are selected, the nucleus of the project team is confirmed.

From this point, and before data collection begins, the ACTIV project officer and scientific assistant work together on the plan of research — more commonly known as the data collection plan. Here the paramount rules are the environmental limitations and variables, the noninterference with tactical operations principle, the scientifically sound sampling techniques, and the deliberate insertion of unbiased data collection questionnaires. The insistence on these points in the project life cycle has established the reputation and "modus operandi" of ACTIV as an impartial agency for in-country combat developments and materiel evaluations.

With an average authorized strength of 27 officers and 25 enlisted men, plus the contract scientific support, how is this possible?

To start with, ACTIV uses a branch material, operational base of PCS officers who are selectively assigned by DCSPER and monitored by the ACTIV liaison officer at OACSFOR. The majority of these officers are selected on the basis of previous research and development or testing experience. From this relatively small operational base of permanent officers, expansion or augmentation to undertake an approved evaluation is accomplished as follows:

- TDY evaluators are requested, using in-country or CONUS based personnel, on an as-required basis to obtain the specific skills or training that best suits the project. By this same method, additional scientific advisors or technical representatives are obtained to provide the specified mix of soldier/scientist skills for the project.
- Contract scientific personnel are continuously available to the project manager for day-to-day preparation of evaluation plans, data collection plans, and questionnaires. They are used extensively in this preliminary project work to provide sampling techniques and questions to impartially pursue all test objectives.
- Through the combination above an overall economy results, sometimes amounting to several manmonths, since TDY evaluators do not normally report to ACTIV until just before beginning the data collection period.

For the most part, project data are collected directly from the users during or at the end of the predetermined data collection period. In addition, personal interviews with users and supervisory personnel in the combat units provide weighted input to the raw data base.

The Army Aviation Division also provides close liaison with evaluation units with its two UH-1Ds and two U-6As. This first-hand knowledge and close working relationship with the combat evaluation units make the ACTIV data collection system unique to the research and development community. In addition, ACTIV's organic aircraft frequently serve as testbeds for evaluating new aviation materiel.

With the meticulous preparation and data collection methods described, data reduction and writing the final report are the least complicated portions of an ACTIV evaluation.

ACTIV's past accomplishments are hardly separable from its future program, since concepts are revised almost daily or new equipment is superseded by scientific breakthroughs. Airborne "people sniffers," bullet detectors, footprintless shoes, airmobile artillery platforms, target acquisition and combat surveillance, AH-1G, LOH, and CH-54 evaluations are but a sampling of the many successful inputs to

The Army Concept Team in Vietnam

ACTIV's history *and* future.

More interesting and challenging is the bright future which includes one or more proposed evaluations in these areas:

• Improved aerial target acquisition and fire support means. Emphasis in this area will be the real time or near real time readout of intelligence to target engagement elements, and to increase the *night* detection, identification and kill capabilities.

• Analyses of current countermine activities with a view to recommending measures to reduce mine and countermine casualties. Interested CONUS laboratories have been asked to send representatives to participate in this study.

• Evaluation of ARVN units and their use of the V-100 Commando armored car to include organization and doctrine, tactics and techniques of employment, logistics and maintenance support.

• A comparative evaluation of the Decca, LORAN C and D, Doppler, and U. S. Marine Corps TULACS (Tactical Unit Locator Air Coordinator System) to determine the effectiveness of each system to meet tactical navigation requirements.

• Examination of the concept and doctrine of employment and operational suitability of the AH-1G (HueyCobra) and the organization required to support it. The evaluation will consider the Cobra's role as a direct fire support, armed escort, air cavalry weapons and armed scout aircraft in the counterinsurgency environment.

• A review of the operations of a heavy helicopter company (CH-54 Flying Crane) in Vietnam, to document its capabilities and limitations in performing tactical logistical airlift missions and to determine its organizational adequacy.

• Further investigation to reduce the fatalities occurring from aircraft combat strikes and accidents, with emphasis towards elimination of postcrash fires.

Thus, it is with an eye to the future that ACTIV ambitiously strives to expedite improvement of materiel and techniques to provide U. S. Army Vietnam with the best possible means to accomplish its tasks.

ACTIV projects include evaluation of the V-100 Commando armored car (below)

Should We Fly Helicopters On Instruments?

The author describes his approach to the next step toward achieving all-weather airmobility

Major Richard L. Eakley

THERE ARE MANY viewpoints on this subject depending on the individual's training, experiences, and equipment that has been available to him. These three have ranged from excellent to barely adequate. There are, unfortunately, aviators who have not had the advantage of all three in the excellent category. Since the goal of Army aviation is 100 percent instrument rated aviators, the question is, What kind of and how much training should the aviator receive? Army aviation has the mission of an all-weather capability; therefore, we must consider the equipment available to the aviator to accomplish the mission. My contention is that the Army needs additional courses for more advanced instrument qualification and better equipment for rotary wing instrument flying.

Let us analyze the requirements in operational units in respect to the goal of 100 percent instrument rating. Generally, pilot requirements fall into three categories: one-third of the pilots able to take-off and climb through and make an instrument approach from visual conditions on top; one-third of the pilots able to operate on instruments in average conditions; and the last third able to fly anywhere, anytime. In my opinion, the present courses available do not meet the requirements to fulfill the Army's mission.

To satisfy the operational requirements, I propose the following type courses:

- Continuation of the present tactical instrument training program with modifications to meet field requirements.
- Continuation of the present Helicopter Instrument Flight Course but delete the basic instrument phase and add the prerequisite that the student have a current tactical instrument rating.
- Establishment of an Advanced Helicopter Instrument Course for qualification for zero-zero operations in all-weather conditions throughout the world.

Aircraft to fulfill the needs should be divided into three groups also. All aircraft should be equipped with what we shall call a basic instrument package, which are the instruments required by regulation. All aircraft should be equipped with receptacles and wiring to accept on a black box quick change basis those additional items to qualify for what we shall call a standard instrument package and an all-weather instrument package. These packages then could be issued to the unit and not by aircraft number as is presently done. This system would provide the greatest flexibility in use based on weather and weight carrying capacity.

Let us examine the tactical instrument rating and the equipment this man needs in his aircraft. He must learn how to fly basic instruments, to include approaches

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MAJ Eakley feels that the Army needs to expand its instrument qualification courses and obtain better equipment for rotary wing instrument flight. His proposals for achieving this are found in his article, "Should We Fly Helicopters On Instruments?"

Should We Fly Helicopters on Instruments?

on partial panel and ground controlled approaches. The ADF approach plus limited en route work following ATC procedures would complete the course. The current tactical instrument card or standard instrument card limited to ADF and GCA approaches would be the goal. Due to field and combat conditions, the full panel of instruments are rarely all operational and the ability to fly partial panel must be an integral part of this training. The present standard equipment on the Huey helicopters is sufficient for this type training and operation.

The Standard Helicopter Instrument Flight Course should have as a prerequisite the possession of the tactical instrument card from the previous course. This course should then be expanded with a brief review of the basic course, plus all types of en route navigation to include Decca or any similar system that may be used. All types of approaches will be included. The award of the standard instrument card for rotary wing aircraft would be appropriate for this course.

The Advanced Instrument Course should then contain a review of all basic and standard procedures. It should cover the operational use of the most advanced equipment available for instrument flight, such as absolute altimeters and automatic hovering and landing systems, to prepare this pilot for absolute zero-zero type takeoffs and landings. These are the category I operations as proposed by the Federal Aviation Agency. This would be a complete new course. The present special instrument card would be appropriate for graduates of this course.

To support this type operational and training requirement, we now need to take a look at equipment.

For basic instrument operation and training, most of the aircraft the Army now has would suffice for both training and operations. Let us call this the basic instrument package.

For the Standard Instrument Course and standard IFR operations in the field, we need as a starting point the basic instrument package plus everything that the airlines are now using. This includes autopilots, weather avoidance radar, transponders, dual navigation systems of all types used anywhere in the world, dual communications capability on the same frequencies, dual power sources, and anti-icing or deicing equipment as appropriate. Let us call this the standard instrument package. At least one-third of the operational fleet should be so equipped, and a training fleet should be established as appropriate to the course.

For the Advanced Instrument Course and all-weather operations, we would require the standard instrument package for the last one-third of the aircraft fleet, plus the most advanced equipment presently available or under development. This would include autopilots with approach couplers, automatic landing systems, and/or automatic hovering systems for helicopters as appropriate with a backup system and automatic switching for malfunctioning. Radio altimeters with absolute altitude readout are a must. Complete anti-icing or deicing equipment is mandatory. Most of this equipment is already operational in U. S. Navy helicopters.

The aviator must learn how to fly basic instruments

Avionics equipment should be of the black box quick change variety

Designed into the aircraft must be such things as auxiliary fuel tanks for the appropriate range and power packages capable of rapid climb at maximum gross weights and suitable speeds at high altitudes. Oxygen systems are mandatory for all crewmembers. All avionics equipment should be designed with the black box quick change capability with an appropriate quantity of spares on hand to eliminate aircraft being on the ground for avionics problems.

This equipment long ago proved economically mandatory for the airlines. Savings on accurate navigation and increased use would more than pay for the equipment. The two biggest weather restrictions are thunderstorms and icing. Weather avoidance radar would permit more flying during thunderstorm activity. Deicing and anti-icing systems would permit more flying during some icing conditions.

The decrease in cockpit workload would increase fatigue-free flight time per aviator and decrease the ratio of aviators required per aircraft. The most often quoted fatigue factor for instrument flying in rotary wing aircraft is 1 hour of flying equals 3 hours of any other type work. Based on the foregoing considerations, this equipment should be removed from the nice-to-have category and placed in the mandatory-before-acceptance category.

There are many arguments against rotary wing instrument flight. These arguments revolve around lack of ability and training of the pilots, unsuitability and instability of the helicopter on instruments, and the question of the necessity of flying a helicopter on instruments with the ability to fly low and slow over the terrain.

My contention is that we must equip and train for the mission to be performed, not reduce the mission to suit the training and equipment available. The helicopter is currently being flown on instruments every day and it can be done. To offset the high degree of attention and concentration currently required for helicopter instrument flying, the autopilot is a must.

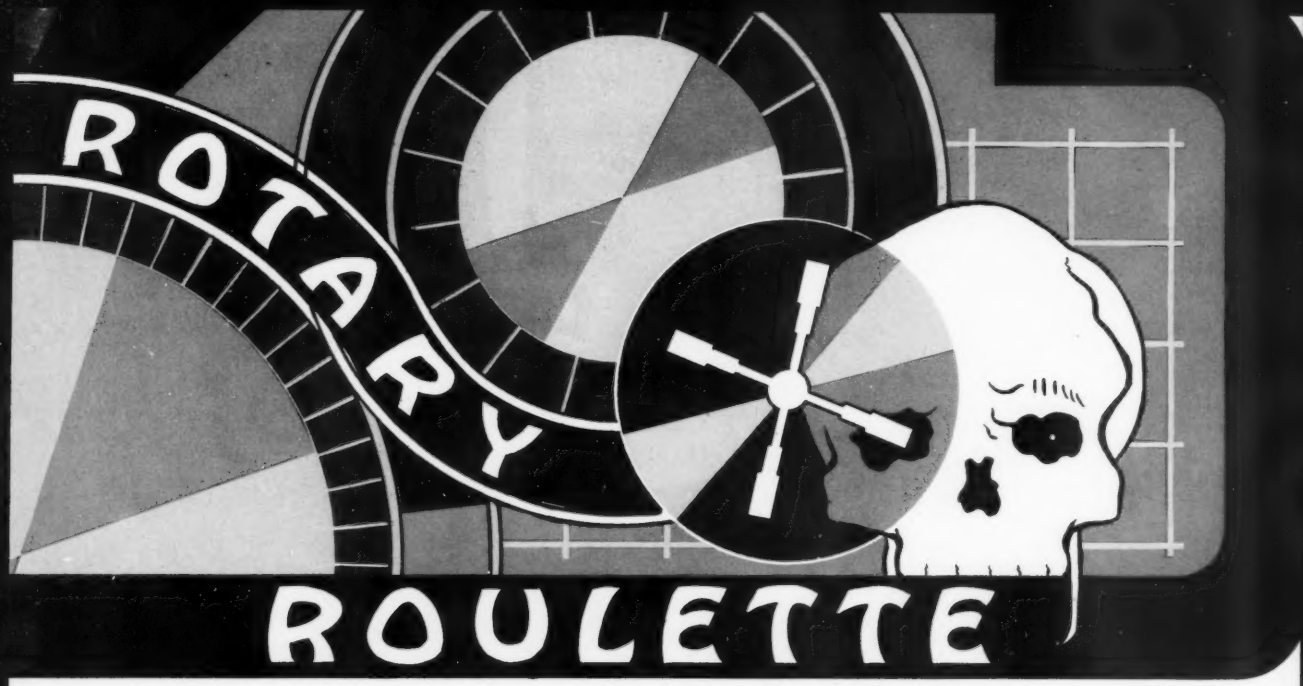
It has been my experience that many missions must either be flown on instruments or cancelled. The controlling factors are many but a few of the more common are changes of elevation, heavy dust concentration, whiteout conditions, fog obscuring the ground, and enemy situation prohibiting the low and slow technique.

In the plateau and mountain regions of the Republic of Vietnam, it is impossible to hover up and down mountains in the dense clouds while traversing the terrain. A straight flight at altitude controlled by an absolute altimeter and weather avoidance radar with a transponder to be monitored by ground radar is the best solution. Tactical approaches to a portable beacon or a GCA to the ground could become routine with proper equipment, such as the U. S. Navy is currently using for a stationary hover over the ocean at night.

In heavy dust concentrations, instrument takeoffs and instrument landings to the ground are mandatory at night. Any other procedure is exceedingly marginal at best. Whiteout conditions in the arctic and fog concentrations fall into the same category with the same procedures required.

Many times in Vietnam the enemy situation has precluded the use of the low and slow technique of flying in marginal weather. Records reflect the dangers involved and the losses attributable to this procedure. The daily newspapers and other sources reflect the Viet Cong's knowledge of the helicopter's limited capabilities in marginal weather. A check on the history of this conflict indicates their plans for an offensive action each monsoon season. Outposts have been overrun during periods of poor weather when the helicopters could not be used for reinforcement or resupply. The mission is there to be performed; we must train our pilots and equip our aircraft to perform *the complete mission.*

These proposals may not be the best or the only ones worth considering. Let us look at the overall goals of Army aviation and an all-weather capability and design aircraft and training programs toward this end and not get lost in a "stop gap" program for the immediate needs. Let's get away from the viewpoint of instrument flight as an emergency measure only and contribute our full share to the Army's mission of victory in battle.



CW2 Francis D. Thornburg

REPUBLIC OF SOUTH Vietnam — July — Captain John Doe with a crew of four and five passengers slipped his UH-1D off the pad. The bird entered translational lift, climbed the barriers, and entered a slight downwind condition. As it shuddered out of translational the rpm began to deteriorate — 6200, 6000, 5800, and no more power. The Huey then settled into the trees, rolled on its side and burned. The aircraft was a total loss, and the gunner was killed. The cause — go no-go placard was not used. (Since the go no-go placard in the Huey simply tells the pilots whether or not the aircraft is overloaded, it will be referred to here as the fly-crash card.) The aircraft was overloaded for the existing conditions. The pilot had 518 combat flying hours in this area.

In December another pilot departed his heliport with ten passengers and a crew of four. He did consult the fly-crash card and found he had 6200 rpm at 96% N_1. Even though the card read "crash," he decided to attempt the takeoff. Sure enough, the rpm decayed and the aircraft crashed into the barriers, resulting in major aircraft damage and injuries to the passengers. This pilot had 558 hours of RVN combat time.

The following day an Army aviator with over 3000 hours flying experience and 237 hours of combat time took off with 11 people aboard. He did not check the fly-crash card and was unable to prevent a loss of rpm. At 5800 rpm he flared and pulled the remaining pitch. The aircraft crashed into a building, killing nine persons in the crash or as a result of the fire.

On and on the record goes. Why do seasoned aviators, not to mention greenhorns, continue this foolhardy practice of attempting to operate when the aircraft is overloaded for existing conditions? The answer to this question and the solution to this problem would save millions of dollars worth of aircraft and an unknown number of human lives.

Present day helicopters cannot be considered underpowered. There is reason to believe that even if the available horsepower was doubled, there would still be a large number of accidents due to being overloaded for existing conditions. This type of accident continues to occur at a steady rate, even though constant command emphasis has been placed to reduce it. If a particular type of accident continues to occur, is the cause still pilot error? Do some aviators presuppose a certain immunity to aerodynamic laws?

Personal observation of accidents, and the unnecessary aircraft and financial losses resulting from them, prompted CW2 Thornburg to write his article, "Rotary Roulette." He is currently stationed at Ft Rucker.

It is apparent that some aviators while in RVN develop a degree of carelessness and overconfidence in their ability and continue to attempt to operate in this prohibited flight regime. I believe that largely these aviators accept overloading as "something they have to live with" to accomplish missions and meet commitments.

It is my opinion that observing a safe operating margin would in the long run far outweigh any advantages attributed to the present system which is followed in many areas.

Possibly a more rigid training program could be initiated. However, this does not seem too practical because the safety margin must be even larger in that area to allow for normal pilot training error. One point that I feel should be more strongly stressed, however, is to teach the student pilot to perform more takeoffs with the minimum amount of power rather than with all the power that is desired. This would develop that essential control touch and make the student more aware of the handling characteristics of the aircraft while flying tactical loads.

Considering the environment, I believe that aircraft maintenance in RVN is in general no less than outstanding. Further, a research of accident investigation reports indicates that mechanical deficiencies are a factor in only a small percentage of aviation accidents.

The standard that has been established at higher levels of command and directed through channels must be applied by the individual aviator. I am aware that a tactical situation demands that procedures and policy must remain flexible and that most of this responsibility remains with the individual aviator. However, it is my unqualified opinion that there is a definite need for enforcing observation of guidelines, as it is obvious that the fly-crash card is not being universally adhered to. Life and death situations may make it necessary to deviate from safe procedures occasionally, but when machines are operated continually in a marginal area, the percentages are high that eventually the machine or the aviator will fall short in a given situation.

Few would expect an aviator to refer to -10 charts before each takeoff; however, he should have at least a mental checklist of pertinent information including:

- safe load
- practical quantity of fuel
- temperature and approximate density altitude
- height and distance to barriers with predetermined aborting point.

These things are considered *before* the fly-crash card check.

It is not my intention to criticize the excellent performance of Army aviators. I would like to point out that I believe operating while overloaded is one of the major causes of aircraft loss and to suggest the need for a more rigid standardization program in this area.

These questions I believe are pertinent to the problem:

- Are we asking too much of our aviators or aircraft?
- Can we justify the frequent loss of aircraft in this area because we are operating in a hostile environment?
- Are our crewchiefs adequately trained in tactical loading?
- Do we have good aviator-ground commander coordination in regard to loads to be flown?

Using the UH-1D for an example and consulting the -10 takeoff distance charts, we find that at a temperature of 95°F, a pressure altitude of 2,000 feet, and a gross weight of 8,000 pounds, the aircraft will not clear a 50-foot barrier, regardless of technique used. This is not an exaggeration and points out the hazard in attempting a takeoff from tactical areas where barriers may exceed 100 feet and the situation may deny the pilot the advantage of effective relative wind during takeoff. In this situation the late realization that the barriers could not be cleared would undoubtedly result in rpm loss and subsequent settling of the aircraft.

Most of our aviators are flying over 100 hours per month without any major problem, and steps have been taken to ensure that aviators do not fly beyond safe limits. In view of this I feel that the problem is not entirely with the aviators but with the loads they are required to fly. I definitely do not believe that a large percentage of these accidents can be justified so easily by the existing situation of bad operating conditions. Generally the use of aircraft seems good except in the case of overloading. All crews that I have observed are cooperative, hard-working and seem to have a good understanding of the aircraft's lifting limitations.

While aviator and ground commander coordination appears satisfactory, I think that ground commanders could become more familiar with how they can best use their birds without exceeding safe limitations. It will be interesting to see what effect the L-13 engine will have, with its greater power rating, or the Huey with the T-67 twin turbine, with its additional 50 percent increase in payload lift and an increased sling load capability.

However, we still have the situation to live with and this I believe can be improved by simply reducing the loads.

I submit that this phase of aircraft operation warrants corrective action by everyone concerned. *We should continue to march, but not before checking the fly-crash card.*

One Way Street

Flying in Vietnam has become a growing nightmare, and the real problem is of our own making — the artillery fire, the other airplanes, and the ever maddening human element

CWO H. P. Hulen

FOR MONTHS WHILE flying an Army Bird Dog I've dodged everything from AK-47 rounds to Boeing 720 jets. I'm tired of it. I know a lot of other people are tired of it, also. Let's do something about the situation.

Flying in Vietnam has become a growing nightmare. From the warmup to the shutdown it's a continuous hazard. Allow me to carry you through a standard day of mine to illustrate my point.

I fly an O-1G for the 184th Aviation Company out of Phu Loi, 25 miles northeast of Saigon. Our mission is to support III Corps, wherever needed. To narrow it down, most of our flying is in support of the 1st and 9th Division Artillery Commands. We have on board an artillery observer every time we go. We fly a 24-hour day.

There's nothing we can do about the enemy gunfire and must learn to live with it, but the real problems are of our own making — the artillery fire, the other airplanes, and the ever-maddening human element.

A mission may begin at 0600 or it may begin at 1800. My mission today will be to fly for 1st Division Artillery. I'm to pick up the AO at Lai Khe, 1st Division's forward CP, at 0630. I preflight in time to make a 0610 takeoff. During warmup, I turn on radios, all three because I'll need them just to get airborne.

Now the fun begins. First a call to Phu Loi Artillery Control to determine what artillery will hamper a safe flight to Lai Khe. "Phu Loi Artillery, Nonstop 21. Phu Loi to Lai Khe."

"Nonstop 21, Phu Loi Artillery. Firing from the southwest battery on an azimuth of 320°, max ord 2,300 feet — 6 klicks. Firing from the northeast battery, azimuth 280°, max ord 1,900 feet for 8 klicks. Firing from position Normandy III (I don't even know where that is) on an azimuth of 165°, max ord 3,500 feet for 3 klicks." (Sounds like mortars. Where's my map?)

Are you beginning to get the picture? Phu Loi runway headings are 13 and 31. How am I even going to get off the field? Our ramp is on the east side of the runway. There are three Huey assault helicopter and two Chinook helicopter companies on the west side with the prevailing winds out of the west. (Good planning, eh?) Let's see what the tower has to say.

"Phu Loi tower, Nonstop 21. Nonstop ramp, taxi takeoff."

"Roger, Nonstop 21. Cleared to taxi on the active for a 31 departure. Caution, I have numerous helicopter departures creating heavy turbulence blowing across

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CWO Hulen wrote his article, "One Way Street," because of his personal experience and concern over the safety, or needless lack thereof, of "crowded air." He offers his partial solutions including better scheduling, control and corridors of operation.

the runway, altimeter 29.95. Call when ready."

Just to taxi I have to use full aileron and rudder, besides almost burning up a brake. Incidentally, I have finally figured it out — how to depart, I mean — to avoid being hit by an artillery round. I must make a hairy right turn to pass south of the northeast battery, completing the turn to a heading of 130°, fly no farther south than the end of the runway, cutting west on a heading of 270° (Normandy III is south of the field about 500 meters) for 10 kilometers, then head north to Lai Khe. (Which is, by the way, on a heading of 310° from Phu Loi.)

After fighting my way to the end of the runway and making my before-takeoff check, I call "Ready."

"Roger 21, wait." I wait while three or four helicopters go, creating a wind equivalent to a small tornado.

"Nonstop 21 cleared for takeoff. Caution, turbulence from departing helicopters, winds (now get this) light and variable." (He's in a 30-foot tower with the wind machine on top.) Not me, I wait for another 30 seconds. I tried that nonsense when I was green.

Away I go. Breaking ground at 50 knots, we wheel in a sharp right, clearing the tents and bunkers by a breath. Just then, four 155s from the northeast battery fire a battery-one, causing the greasy eggs to jump up to where they came from, or almost. That's where they'll stay the rest of the day. One more call to Nonstop Control, informing them that I am "safely" in the air. (I think they doubt you'll make it off the ground, sometimes.)

I failed to mention that a heading of 270° from Phu Loi takes you over an ARVN compound that usually starts the rifle range about this time. They do. I'm about 700 feet as I pass over, and the M-1 fire breaks loose. Eggs up another notch.

Tooling on out, I come nose to nose with about six choppers, three Bird Dogs and a Mohawk, all coming home from night missions. (They found the "safe" way into Phu Loi.) Dodging them and getting squared away on course, north, I remember this will take me within range of artillery being fired from Cu Chi to the west. So — I call them, only to find that I must swing a little east immediately after clearing the fire coming out of Phu Loi.

Climb to an altitude above the max ord, you say? Not on your life. That's where all the Caribou, Provider, A-1E, C-130 type aircraft fly. Many, many of them. Not to mention the F-100, F-4C and commercial jets taking off from and landing at Bien Hoa and Saigon. With the 1,500 foot scud layer that persists most mornings in this area, you would have to go AI for a few seconds.

Halfway to Lai Khe switch to Lai Khe artillery frequency and go through the same routine. Finally, in the Lai Khe pattern, "Be advised that you are cleared to land at pilot's discretion. Heavy helicopter departure traffic." What's new? Lai Khe's strip is a widening of the road cut through a rubber plantation. Once you drop below tree level, you are in a bowl of turbulence. The Hueys keep the air constantly astir. Interesting place to land a small, fixed-wing aircraft. Every one a controlled crash. I made it. Eggs up another notch.

The observer is ready (dammit). He climbs in and away we go. The

Aviators must remain aware of latest artillery plots

takeoff is worse than the landing (his eggs are up now). I found that I could get out of the Lai Khe area headed north only by going south and west for 5 miles, and that at low level (below 300) for 3 miles over Charlie country. No fire today. Charlie's slipping.

"What's the mission today?"

"Well, we have to adjust registrations for four batteries here at Lai Khe, one at Chou Thaun, two at Quon Loi, and one at fire support base Lorraine. After that, we provide convoy cover between Chou Thaun and Lai Khe. While en route we will recon the roads, etc., between points."

This takes us over the northern third of III Corps area.

Now we begin running into the second of our real hazards — the other airplane. On our mission today, while registering, a FAC Bird Dog came from my right front on a collision course. I maneuvered so as to be able to see the pilot as he flew by without causing a dangerous situation. He was looking down from his right window, not knowing I existed. I remarked to the AO that if I only had a horn I bet he'd jump right out of his shoulder harness. I don't think he ever knew how close he had come.

Another hazard involves airstrikes. The Army must, for self-preservation, maintain a warning system that provides *all* pilots with up-to-date knowledge of any artillery or mortar firing in a given area. This is available to any pilot desiring the information. On the other hand, the Air Force, because of direct contact on VHF, FM, and UHF frequencies, is set up to bomb, strafe, and rocket at will when cleared by the ground troops. This leaves the Army aviator to do the dodging — not always successfully.

We have a mission to perform, also. I realize that it is most important that an airstrike not be delayed because of economical factors. I do not advocate any great changes in the system, but I do think something could and should be done — allotting airspace on a mission basis, establishing air routes and corridors of operation, standardizing frequencies and methods of issuing data. For instance, what good does the info "firing from the 20 miles DME fix on the Saigon Tacan 180° radial to a point 40 miles on the 270° radial" do me, a Bird Dog pilot? None — and yet this method is used by the Air Force and Marine Corps in certain areas. Let's get together.

All single-engined aircraft pilots prefer to orbit to the left. It's natural and it's easier, making it safer. But — no, a division commander flying in his command and control Huey, orbiting right, decides that all aircraft will orbit right. So round and round you go, maintaining an altitude of 2,000 feet over the operation, providing the AO the best possible vantage point to do the mission assigned. The C&C ship need not even be there. Why not assign the artillery observer altitudes of 2,000 feet to 2,500 feet, the C&C ship 1,500 feet, the gun ships 1,000 feet and below. Would this be too great a problem? I don't believe it would.

To touch on another factor — the human element. I have found that in too many instances the training has not been complete in the States. I speak, not of adequacy of pilot training as concerns the mechanics of handling the aircraft, but of the complete training of the aviator.

For example, is the Huey trainee taught the effect of rotor wash on a light fixed wing aircraft such as the O-1? I don't think so. Is the Chinook pilot taught that he shouldn't pull pitch while sitting alongside a runway until he's sure there are no landings or takeoffs in progress? I don't think so. Is the Mohawk pilot taught that although he has visual reference with the lighted aircraft at night the other pilot can't see him and is scared to death when the Mohawk roars by him unannounced? I don't think so. Are the tower operators taught that a Huey and an O-1 can't land side by side with the Huey upwind? I don't think so.

I could site many more personal experiences that have confronted me. Multiply these by the 2,000 plus Army aviators in Vietnam, and you have an increasing amount of bedlam and wrought nerves.

The aviator in Vietnam today is on a "one way street," going the wrong way. If he remains aware of this fact at all times and can make allowances for all the "other nuts," he'll make it through. The other guy always sees himself in the right. Through no fault of its own, the Air Force is on the "one way street" with you, always having the right-of-way. But because of the system presently used, we find it increasingly difficult to perform our mission on the same street with all other aircraft. The necessary artillery creates a situation that often leaves you with a "one way street."

Out of this I would like to see training improved for the pre-Vietnam pilot to an extent that he would, at least, be aware of the many hazards of flight he may encounter while there so he would not add to another's woes.

I would like to see a system of air traffic control established to help eliminate conflicts of flight in a given area, and I would like to see more thought and planning put into artillery fire to eliminate the ridiculous situation where a southern-most battery fires to the north over a northern-placed battery firing to the south, etc. We need a thorough standardization of systems throughout the country.

CRANK—HOVER—CRASH!

Huey takeoff accidents account for most noncombat helicopter losses in Vietnam. This type of accident can be eliminated

AIRCRAFT LOSSES in Vietnam due to accidents are more numerous than aircraft lost in combat. Not only are we losing aircraft, but the personnel who fly and man them are occasionally injured or killed. In addition, some units suffer from reduced capability to accomplish their mission because of a shortage of mission ready aircraft. More aircraft would be available if our noncombat losses were decreased.

The most common type of aircraft accident in the Huey, our primary helicopter in Vietnam, occurs during takeoff. We've all read several pilots' postaccident statements which read almost invariably, "Aircraft lost power during takeoff and I could not avoid obstacles in our flight path." This type accident can be eliminated.

Why do we encounter this particular problem in Vietnam? There are several reasons for our high number of crashes during takeoff. The hot climate in Vietnam coupled with heavy loads are certainly contributing factors. Our gunships are carrying tremendous loads. The two door gunners, external weapons system, ammunition, and miscellaneous equipment constitute quite a load. Even our slick ships are carrying heavier loads than anticipated.

But the factors of high density altitude and high gross weight should not be insurmountable. We should be able to operate effectively and safely, even under such adverse conditions. Many units are, in fact, doing so.

Considering several aircraft accidents that occurred during takeoff in Vietnam, at least one unit certainly has had more than its share of bad luck. Take a quick look at the following accidents which all occurred in the same unit, all involving UH-1B gunships armed with the XM-16 system, all occurring during takeoff, and all in a short 10-month period.

Accident number one: This experienced aviator was assigned an early morning mission to support ground troops in his assigned gunship. With two door gunners and

Crank — Hover — Crash!

a fairly inexperienced copilot aboard, he prepared for an 0530 takeoff. Preflight and runup were normal. After receiving clearance, the aircraft commander slowly picked up the aircraft to a 15-foot hover. He selected this altitude because of ground obstacles around the aircraft.

Unfortunately, in ascending to this high hover, he failed to obtain a power check; nor was he able to get the feel of the aircraft. The aircraft did two complete turns before crashing in a level attitude. The turns were caused by loss of tail rotor control due to low rpm. The aircraft sustained major damage to the fuselage and tail boom. There were no injuries.

Accident number two: This accident was very similar to accident number one. However, both the aircraft commander and his copilot were more experienced. A gunship; 0600 takeoff. Preflight and runup normal. Ascent directly to 15-foot hover, rpm loss — crash. Even damage to the aircraft was identical. The aircraft commander stated that he did not obtain a hover power check because of obstacles in the landing area and density altitude was unknown.

Accident number three: This very experienced aviator had flown approximately 6 hours during the day. In preparation for his last assigned mission he returned to his home field for refueling and rearming. After loading his XM-16 with rockets and 7.62 ammunition, he hovered to the refuel point where the crewchief filled the aircraft to capacity. Crewchief, door gunner and copilot all loaded aboard, anticipating the hot chow and shower that was just one short mission away.

The aircraft commander determined the wind and density altitude. He selected his takeoff path over a fence located about 30 meters distant, into the known wind. The aircraft was beeped to maximum rpm. Realizing that he had a heavily loaded aircraft, the aircraft commander very slowly lifted the ship to a low hover. Rpm held. With gentle care, he lowered the nose and increased collective pitch slightly. As the aircraft started forward, rpm began to fade. At about the halfway point between his takeoff point and the fence, the rpm was estimated to be 6200. The aircraft continued in a straight line, never reaching an altitude sufficient to clear the barrier. Both front skids hooked under the fence and the aircraft flipped over inverted. All crewmembers exited unhurt and watched the aircraft burn.

Accident number four: This accident involved a gunship with an aircraft commander having several years of helicopter experience. In this situation, the aircraft commander complained that his assigned load was too heavy, but no one could help him since the entire unit was moving from one location to another. It was necessary to load everything on the aircraft in order to arrive in the new area of operations fit to perform any mission assigned.

Thus, bedrolls, shaving kits, and all the miscellaneous equipment that four crewmembers had obtained during the past few weeks were loaded on the unfortunate aircraft. There was barely room for the door gunner and crewchief to sit. Equipment was loaded to the ceiling. Realizing that he was over gross weight and knowing, too, that at high noon the density altitude was as high as it would likely be all day, the pilot was frankly concerned.

A ground recon of his takeoff area was made. He determined that with about 250 meters of flat level terrain in which to become airborne, he could make it. With that type of terrain and with a slight head wind, he decided that perhaps he was being too concerned over such a simple thing as a takeoff.

The crew loaded on, everything was strapped down, all checks completed, and the helicopter cranked. With maximum rpm the poor beast would not hover. But it would slide along the ground. So after sliding out and placing the aircraft at the extreme end of his takeoff lane, the aircraft commander instructed his crew to tighten seat belts and lock shoulder harnesses. He then got the aircraft as light as possible on the skids and applied forward cyclic. After travelling about 20 meters, the aircraft became airborne and climbed to a height of about 3 feet, where it travelled for approximately 100 yards. Rpm during this time was fairly stable.

The aircraft commander states: "About the time I felt we were going into translational lift, I raised the nose slightly to begin a normal climb. However, the aircraft began to settle and rpm then started falling. I saw that I could not clear the trees at the end of my takeoff area, so in order to avoid obstacles, and also to try to obtain additional rpm, I executed a right 90° turn. At this point I realized the aircraft would just not fly. All my efforts were then directed to putting the aircraft on the ground in one piece."

Unfortunately, the pilot was not successful. The aircraft slammed into the ground, shearing the landing gear and incurring extensive damage to all components. No one was injured. Later when the aircraft was unloaded in preparation for evacuation, it was apparent that the aircraft could never have become airborne with the load it carried. In fact, it looked as if the aircraft had enough gear and mis-

cellaneous equipment to outfit a squad of men rather than just four crewmembers.

Accident number five: This was the last accident considered. The reason? Aircraft were in short supply. And by this time the Old Man had put out the word there would be no more accidents.

This aviator possessed vast experience in helicopter operations. The accident occurred during his first week in Vietnam. Having just returned from one mission, the pilot proceeded to the refuel point where his crewchief refueled the aircraft. The door gunner during this time replenished the weapon system basic load to include ammunition for both door gunners. Another mission was immediately assigned the crew.

Since aircraft had been taking off and arriving at this particular field location, no difficulties were expected by the pilot. All crewmembers loaded and the aircraft was cranked. The pilot felt that the aircraft reacted rather sluggishly at a low hover but was not overly concerned. He had a mission to perform, so he selected his takeoff path and began.

The takeoff area available was approximately 1 mile long with no obstacles present. However, the ground surface was soft and sandy. Collective pitch was applied and the aircraft hovered at about 1 foot off the ground. The nose was lowered and the takeoff began. The aircraft travelled approximately 50 yards at an altitude of 1 to 3 feet before settling back into the ground at about 5 to 10 knots airspeed. The rpm had bled off to approximately 5800. Contact with the earth could not be cushioned. Although no injuries were sustained, major damage was incurred to the aircraft fuselage and tailboom.

Since several days passed before the aircraft could be evacuated, many people had the opportunity to observe the bent and broken bird lying in the middle of one of the largest fields in Vietnam. It's certain they wondered how in the world it could have happened.

All of these accidents had several things in common. In addition to belonging to the same unit, they were all gunships operating over the recommended gross weight. They all occurred in a combat area under trying field conditions during sustained operations. In all cases the aircraft commander was an experienced aviator assigned a combat mission.

What mistakes were made? What safety precautions were violated? What caused and how can we prevent further aircraft losses of this type? These questions are for accident boards to consider.

> . . . I realized the aircraft would just not fly. All my efforts were then directed to putting it on the ground in one piece

Speculation will not be offered here. However, the measures taken by the unit to prevent further accidents of this nature are known and can be discussed.

All assigned aircraft were inspected periodically to remove excess weight. Only essentials were left on board. The basic load of ammunition for gunships was reduced. Each crewmember was limited to one small bag for personal effects regardless of the length of the combat operation. Cots and other luxuries were left in garrison as were excess personnel.

The policy of moving a unit in its entirety in just one move was abolished. When moving the unit, lift ships were required to make two lifts to carry excess baggage and equipment. Gunships were half loaded with ammunition and fuel to allow for the extra baggage and weight required during moves to a new location.

Classes were conducted on techniques of operating with loads to include lessons learned from previous accidents. In addition, more training was conducted on the meaning and application of the go no-go placards. These classes were recurring to train new personnel.

The maintenance unit was directed to ensure that go no-go placards were mounted in each aircraft and checked periodically for accuracy.

New personnel were given an extensive checkout in the particular aircraft that they would be assigned. The checkout stressed takeoffs with loads. It included the conduct of actual missions with a unit instructor pilot on board.

Finally, the commander's policy was stated and made known: Aircraft would not be operated over maximum gross weight. No aircraft would attempt a takeoff if the aircraft would not hover without loss of rpm. The limitations imposed by the go no-go placard for the particular aircraft would be adhered to. In addition, aviators of the unit were advised that if during takeoff rpm was lost, the takeoff would be aborted immediately and engine failure procedures executed.

Although this corrective action came a little late to help the aircraft already damaged, it did prove thereafter to be successful. Further measures taken by the commander "out behind the barn" are unknown, but accidents during takeoff were drastically reduced. The unit's mission readiness posture was improved. Successful operations were continued against the enemy — even under the adverse conditions of high temperatures, high gross weights, and a tough field combat situation.

When was the last time you checked the

Swashplate Support Assembly?

I stuck my head up under the swashplate as best I could and the tech inspector moved the assembly. I had found the cause, and at the same time was dumbfounded

CW2 Frederick S. Minnich

MAINTENANCE is an exacting process with parts or pieces of equipment functioning correctly or incorrectly. Guidelines exist to check and correct discrepancies, and real thought problems do not arise except when the faulty part or parts cannot be pinpointed. This brings up the first real problem I encountered in my relatively new position as assistant maintenance officer.

The maintenance officer and I were discussing a pilot writeup on a UH-1D. It had a severe 1:1 vertical vibration.

I talked to the pilot who had flown the aircraft. The only thing that he could positively say was that the more power applied and the higher the collective pitch was raised, the more severe the vertical became, and at 100 knots he considered the aircraft unsafe.

This did not sound like a normal out of track situation. Did the vertical vary in degree with the airspeed or power, or both? Was it present at a hover?

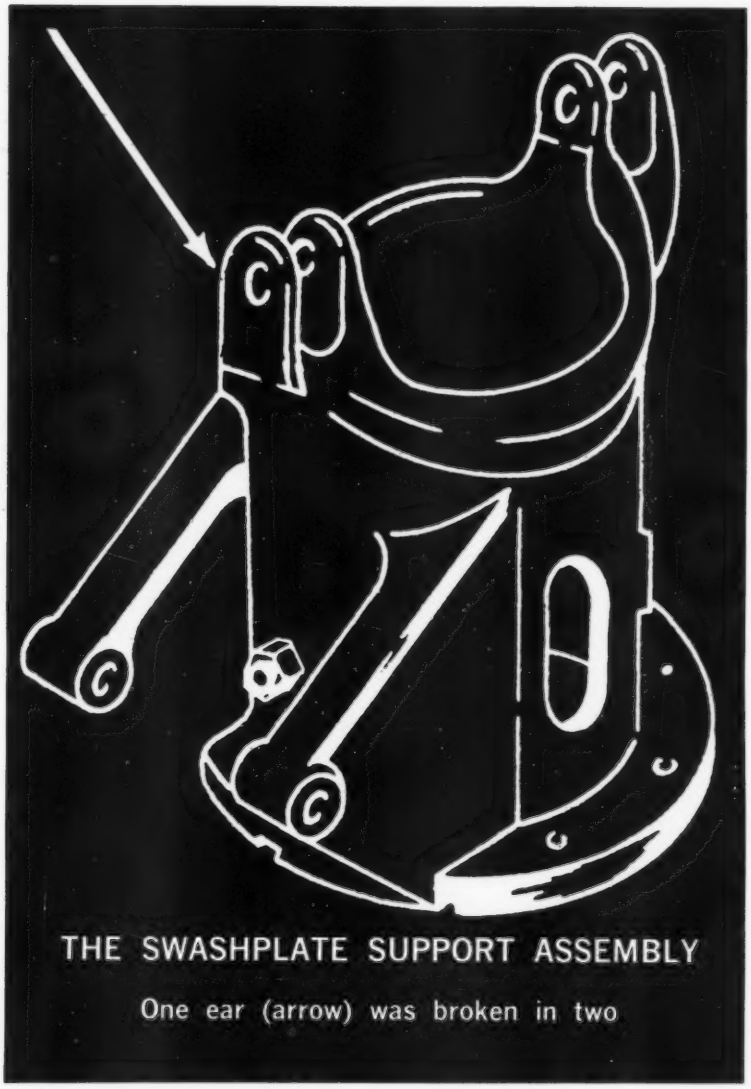
I rounded up the best tracking team and the best tech inspector in the service platoon. I had one specialist who was outstanding at tracking and exceptional in all other areas. We went out to the aircraft and began a thorough preflight. Minor faults were found but nothing of great importance, even though three people went over the transmission and rotor head.

I cleared and proceeded to start the aircraft. I tried to detect any abnormalities during runup, but encountered nothing. At 6000 rpm there appeared to be no vertical with collective down. The same applied at 6600 rpm, but it was a different story as I applied power. The vertical appeared at 15 pounds of torque and increased at hover. A visual tip path check showed the blades about 4-6 inches apart at a stationary hover. I slowly decreased power to full down and the vibration deteriorated to nothing.

I hovered the aircraft over to the maintenance ramp and shut it down. My people marked the blades and zeroed the trim tabs.

We then took a track according to normal procedures. It appeared that I had been about right: the blades were 4-5 inches out of track. The necessary adjustments were made and a low and high track were taken. The blades appeared to be in track and the fine adjustment could be made with the tabs. I cranked and slowly picked the aircraft up to a hover. The vertical was now more severe than it had been before, which did not even make sense. I set the aircraft back down and shut down.

CW2 Minnich gives a personal account of an unusual way of solving a maintenance problem while serving as an assistant maintenance officer. His experience demonstrates the need to frequently check the swashplate during preflight.



THE SWASHPLATE SUPPORT ASSEMBLY

One ear (arrow) was broken in two

What could cause this situation? This question ran through my mind. We checked out a couple of things, took another track, made the necessary adjustments and came up with the same situation.

At this point I decided there was only one way to find out what was causing the problem: I would start from the bottom of the transmission and check every component part to the J nut.

The airframe checked out OK. The transmission mounts checked, the left link, transmission, servos and push pull tubes, collective scissor and sleeve checked. The swashplate support assembly and swashplate checked, and everything else checked all the way up. I had not personally checked each item, but a competent tech inspector checked the things that I had not inspected. We had found nothing.

Finally I decided to make a somewhat different check. I decided to crank again. I asked my people to stand around the aircraft and look for any abnormal movement when power was applied. I tried this both at flight idle and 6600 rpm with as much pitch as possible without a hover. Nothing was noticed. I then picked it up to a hover. Still nothing was noticed from sides or front.

I shut down and climbed up onto the helicopter with my tracking people. We were just discussing the problem and not really coming up with anything reasonable. I had my hand on the star assembly where the swashplate turns in. I just turned to my tech inspector and nonchalantly said, "This bird really has me puzzled." To emphasize "bird," I hit the trunnion mount with the heel of my hand. It moved.

I grabbed the star assembly with two hands and there was plenty of lateral movement. I stuck my head up under the swashplate as best I could and the tech inspector moved the assembly. I had found the cause, and at the same time was dumbfounded. One ear on the swashplate support was broken in two. When the star assembly was released, the two broken pieces moved back to their normal position and the break was practically impossible to detect due to its location.

In a no-lift situation, the unbroken ear of the swashplate support provided enough strength to maintain the swashplate in a normal position. However, with the application of collective, the control loads caused the swashplate to raise at the broken side of the support ear causing the vertical vibration.

The life of the unbroken ear is not known. However, loss of control would result if it failed also.

Next time you preflight your Iroquois, get your head up under the swashplate and look.

CH-37 Mo

While the Mojave's absence is pages, CH-37s of the 19th Av

WHERE ARE THE Mojaves? Have they become obsolescent? These are questions which Army aviators might ask themselves upon examination of aviation units located within the United States. This giant helicopter has been a familiar sight for military as well as civilian personnel since it was introduced into the Army's inventory during the midfifties. Its recent absence from military reservations might suggest that the CH-37 has been placed in retirement.

As late as 1966 this twin engine, single rotor helicopter was a familiar sight for residents of Fort Sill, Okla. However, introduction

ojave—Workhorse of Korea

s conspicuous in many areas, its presence is fully evident in Korea. As depicted on these viation Company are establishing an impressive reputation

Captain Rush R. Wicker

of the CH-47 Chinook necessitated relocation of the aircraft. An inspection of the helipad at Hanchey Field, Fort Rucker, Ala., would reveal a handful of these distinctively shaped helicopters. Further investigation of the whereabouts of Sikorsky's largest reciprocating engine helicopter reveals that the Army National Guard has acquired a large number of the CH-37s.

Thus far our search has been limited to CONUS. A look across the Atlantic into Europe reveals that two companies of CH-37s are located with the Seventh United States Army. A final look takes us to the historic country of Korea and the home of the 19th Aviation Company (Medium Helicopter CH-37).

The 19th began as Company I, 466th Quartermaster Truck Regiment on 10 November 1942. It wasn't until 15 July 1959 that the unit was converted into a medium helicopter company. The purpose of the conversion was to provide the Army with a medium lift helicopter capability. The unit's primary mission at the time of its activation was to support the United States Army Infantry Center located at Fort Benning, Ga., and other installations in the United States and the Panama Canal Zone.

This medium helicopter unit is now located at Camp Humphreys some 35 air miles from the city of Seoul. Calling a set of hangars and an 8,000-foot runway home, these men and helicopters are considered to be the workhorse unit of Korea. Strength, stamina and durability is more than just a motto for the 19th Aviation Company; it is a way of life. Since making Korea home the unit has established an impressive list of records.

Common to the 19th are the numerous rescue missions the com-

CPT Wicker was the commanding officer of the 19th Aviation Company while serving in Korea. Currently he is stationed at Ft Rucker.

CH-37 — Workhorse of Korea

pany flies during the Korean flood season. During the early morning hours of 13 September 1964 torrential rains flooded many rivers in Korea leaving hundreds homeless and trapped. One of the hardest hit areas was a small island in the Kukchon River. Within an hour after notification the 19th had a CH-37 on its way, which was later joined by two more helicopters. Over 1,000 people were evacuated from the island. Since this dramatic event took place, the 19th has won the heart of most Koreans. Each year during the flood season the pilots of giant Mojaves await the request for their assistance.

The Red Carpet treatment is indicative of the pride which the 19th Aviation Company exhibits when called upon to transport VIPs. Although not a primary mission, the capability of the CH-37 to lift 23 passengers has prompted many requests for this service. Any day that you read in your newspaper that an armistice meeting was held at Panmunjom, you can rest assured that the Mojave has been called upon to perform another mission. It is the responsibility of the unit to transport the armistice team of 23 members to the historical site where the United Nations and the North Koreans meet for these conferences. The appearance of the giant helicopter approaching the helipad, located within walking distance of the armistice site, has left a formidable impression upon the North Koreans.

The President of Korea and his top assistants are but a few of the Korean dignitaries who have called upon the Mojave. Not only have the Koreans requested the assistance of the 19th, but American dignitaries have also flown aboard the giant helicopter. In November of 1966 the President of the United States visited Korea. Once again the Mojave was called upon to provide the lift necessary to support a presidential visit.

The deployment of Korean troops to Vietnam was a big morale boost for Americans as well as the Korean people. News media have described the effectiveness of these troops in air assaults. But where did they become familiar with airmobile operations? The answer again reflects the workhorse of Korea, the giant Mojave. It was the 19th Aviation Company that was assigned the responsibility to familiarize these troops with airmobile assaults.

Once again the rice paddies of this Asian nation were turned into a simulated battlefield. And, rather than the troops having to traverse the mountains by foot, the helicopter added a new perspective, airmobility. This type of transportation was new to the troops. However, the technical supervision provided by the crews of the Mojaves soon resulted in a coordinated operation that qualified the ROKs as an effective airmobile force. It is quite evident that the CH-37 Mojave has played an important role in Vietnam and will continue to assist in the struggle against communism as long as the ROK soldier serves in Vietnam.

Logistical support is essential for any military operation. In some areas of the world this mission can be accomplished with the conventional vehicle. Such is not the case in Korea. A map reconnaissance of this country reveals mountainous terrain from the DMZ in the north to the city of Pusan in the south. Further study reveals that Korea is handicapped because of inadequate roads. How do the isolated air defense sites on the high mountains and the outposts along the DMZ receive logistical support? The answer is once again the CH-37 Mojave.

The capability of this helicopter to lift 2½ tons in a single lift has qualified it to perform almost any resupply mission requested of the 19th Aviation Company. It isn't unusual for this unit to be called upon for an emergency resupply mission in any part of the country. This type of mission is quite common during the winter months when extremely cold temperatures place a greater restriction upon land and water travel.

Korean troops who guard the demilitarized zone from North Korean infiltrators have on numerous occasions found themselves isolated as a result of frozen rivers and snow blocked roads. The sight of a giant Mojave and its valuable cargo has provided encouragement for these troops to continue their efforts to defend against communism, which is a never ending threat in this part of the world.

During recent years increased emphasis has been placed upon surface to air missile systems and radar surveillance. The terrain upon which these sites have been constructed is impassable to conventional travel during adverse weather conditions. It is the CH-37 Mojave which has delivered the food for the personnel and provided the heavy lift capability needed to move equipment to these remote sites. In addition to providing these much needed supplies, transport of the many personnel required to operate the missile range used in annual service practice has become another important mission performed by the CH-37 Mojave.

Has the CH-37 become obsolescent? Upon evaluation of the many missions performed by the Mojave, it seems that this helicopter definitely continues to play an important role in today's modern Army.

VFR

continued from page 1

pleted this maneuver in the type aircraft for which he is being checked. If aviators are not allowed to become proficient in performing emergency procedures through practice, how will they react when faced with an actual emergency? Moreover, a pilot may attempt the maneuver unsuccessfully for 99 consecutive attempts, and then perform it successfully on his 100th try. This means he is proficient and needs no further practice? Hardly; however, that is what the investigating board is, in effect, saying.

The board then recommended that straight-in autorotations not be practiced or demonstrated unless the pilot being checked has not successfully completed this maneuver during the previous 90 days. While being more realistic than the previous recommendation, this one also shortchanges the aviator and his passengers who are entrusting their lives to his proficiency. What about the aviator who feels his autorotative technique is substandard and desires to improve his ability with additional practice? Acceptance of the board's recommendations denies him this practice. If emergency procedures are not practiced, how much time and lives will be lost while the nonproficient aviator is evaluating an emergency and deciding what to do about it? Why not just ground all our machines so we can enjoy an accident rate of zero, while at the same time we can fool ourselves about how proficient and professional we are since we don't have accidents?

The reviewing official's statement "Concur with the findings and recommendations of the board" is its own indictment. However, I would like to comment on the statement that "Current policy prohibits practice autorotations, except for transition training and instructor pilot proficiency." The reviewing official has also shortchanged the pilot by effectively ordering him to neither acquire nor maintain proficiency through practice.

The first indorsement to the letter of transmittal is mentioned here because this official has shortchanged the pilot by accepting the board's recommendations and the statements and actions of the reviewing official.

Much ado has been made about the professionalism and the excellent job performance of Army aviation, especially in RVN. We are doing a good job, but we are hardly professional. The above cited accident investigation is a lucid example why we are not professional: we are not allowed to be. The rated aviators on the board betrayed their fellow pilots by recommending prohibition of autorotation practice. The Army desires that aviators maintain proficiency in a variety of aircraft; this is a professional approach. But how can it be done when aviators are saddled with such limitations as those proposed by the board and approved by the reviewing official?

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APO New York 09029

Sir:

There is an acute need for aviation liaison officers at aviation company level in Vietnam. This need becomes most evident to the aviators in the air no matter what their mission. During artillery lifts, troop lifts, fire support missions, or moving the brigade mess hall this man can save the aviation commander and the ground commanders, whom he may have to support, valuable time, expensive equipment, frayed nerves on both ends of the "stick," and give polish to the operation as a whole. His value can only be felt if he is on the ground, located with the supported unit, to give counsel and advice, keeping in communication with his commander so that he may advise on times, location, aircraft requirements and give type load information.

He also takes on a secondary role as safety officer, ensuring that loads are rigged properly and their weight is within technical tolerances for a particular day.

Before an artillery battery tactical move from one combat landing zone to another, where it will be required to give fire support to the ground forces as soon as the tubes are implaced, our man should be there on the ground with the battery commander organizing his unit for the move. The aviation liaison officer will take into consideration the distance to be moved and the number and type of loads so that he may advise the aviation commander of the number of aircraft required for the mission. He will personally check each load for proper rigging and weight limitations. This may prevent the needless loss of an artillery piece or, more important, the loss of life. He will brief the "hookup" man on his job during external load operations.

During the move he will provide his own ground-to-air communications, be aircraft controller in the "pickup" zone and keep the mission leader advised of any changes or delays. It would also be advantageous if he were included in making the selection of new artillery positions so that he may advise as to the size and improvements needed so that the pilot can better do his job.

Many things should be considered in the layout of the landing zone. The location of the fire direction center near a helicopter landing pad or ammo resupply point can result in the loss of valuable paperwork with the arrival of each set of whirling blades. Ammunition resupply points and landing pads should be in an area where they will not interfere with the normal operations such as chow time, keeping in mind approach and takeoff lanes for the choppers. Many aircraft accidents are caused because the pilots did not have a choice for takeoff or landing.

The LNO should be consulted on the sites for water and fuel blivets which are hauled into the artillery position and lost because of sloping terrain. Even on level ground the big, windy Chinook or Flying Crane may turn them into a 15 mph steam roller type vehicle which can destroy valuable property and kill. The choice of landing pads for small and large helicopters should be separated so that light aircraft will not be damaged.

Now we see that an area which fits the tactical situation is not always suitable from an aviation standpoint, and an area which fits our needs may not satisfy the tactical requirements. Here is where our man on the ground comes into the picture with the supported unit commander and in most cases a compromise will be necessary to determine factors such as minimum size required for landing pad, depending on types and size of aircraft which are to use the area and the loads the aircraft will deliver. Bivouacs and closeness of working troops must be thought of from the standpoint of air traffic.

In combat, standard approaches into forward landing zones are avoided; still, there are only so many ways to get into an area. Are these approaches free of obstacles? This is particularly important for night operations.

Now we see that the aviation liaison officer is a "jack-of-all-trades" and can be important to the aviation and ground commanders, but most of all to the pilots.

CPT Gerald R. Worthington
Dept of Rotary Wing Tng
Ft Rucker, Ala. 36360

crash sense

the following 28 pages prepared by the U. S. Army Board for Aviation Accident Research

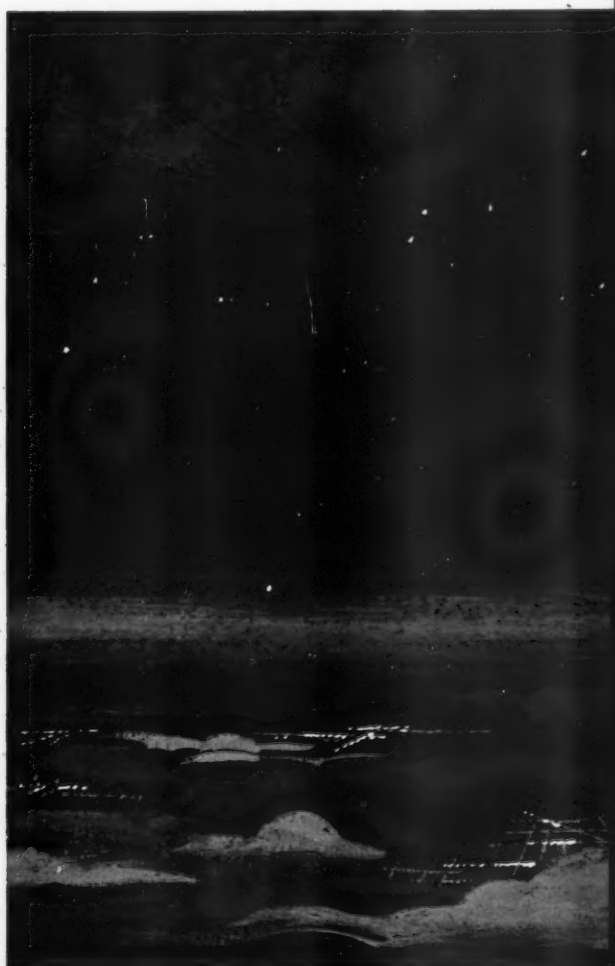
the pilot told the air route traffic control center he was having . . .

A LITTLE FUEL PROBLEM

U-6A PILOT: ". . . I called my copilot and told him to plan for a takeoff shortly after midnight . . . .

"That evening I received a call from the copilot. He couldn't get off to make the trip. I called two other pilots and they couldn't make it either. I decided to call a nonrated officer whom I had flown with before. Although not a rated pilot, he can function as a copilot by handling the radios and he can also fly straight and level to permit brief periods of relief for the pilot. He cleared the flight with his CO and called me back to tell me he'd come along.

"I planned to start early and probably fly 12-15 hours. From experience, I knew that an 18-19 hour day does not fatigue me too much, as long as I stop around sunset, and make frequent stops en route, at least every 4 hours . . . . But I didn't want to



commit myself to a rigid plan because I didn't know how that particular day would be. I told the passengers we could make it a comfortable flight and that it depended on how I felt later on during the day as to how far we would get.

"I asked the nonrated officer to come by my house at 2300, and I went to bed early so I could get a couple of hours of sleep. I got up at 2230 and felt quite rested. I normally get to bed 15-30 minutes after midnight and get up about 0600-0630.

"The weather forecast indicated that the front which concerned me earlier during the day had dissipated and only low stratus remained. It had also left an area well within my reach in the clear. The first leg would have to be longer than I wanted, but well within my limits. After checking the weather again, I selected a destination 474 nautical miles away, estimating it would take about 4:45 to fly there. I chose an alternate which still left me with 1 hour of fuel reserve — counting 6 hours of fuel aboard.

". . . I checked out the parachutes and a headset for the nonrated officer, then went out to the aircraft to preflight and brief the three passengers. I asked one who knew how to show the other two how to fit the chutes and how to use them. I told him I would give them the rest of the instructions. I started the preflight, checking fuel quantity and transfer, and drained some fuel on the ground. When I got around to the front of the aircraft, I was called to the telephone in operations. The nonrated officer had gone back to my house to pick up a suit I had left at home. He had car trouble and I decided to go and get him. I told the dispatcher to extend my

A LITTLE FUEL PROBLEM

I received a call from the copilot;
he couldn't make the trip.
I called two other pilots and
they couldn't make it either.
I decided to call a
nonrated officer . . .

estimated time of departure by 30 minutes. When I returned . . . I walked out to the aircraft, rechecked switches off, took up my preflight at the propeller, and continued around clockwise.

"I drained a small amount of fuel from the tip tanks by reaching up with my hand. I did not look inside the tip tanks. I think I was satisfied that they were full. The transfer worked and I had made a special point that all tanks were to be filled, and to make certain that the aircraft had tip tanks as I would probably need them for the first leg due to the weather. I was reassured by the maintenance man that the aircraft had tip tanks, that they were filled, and that the aircraft had enough time left to the next inspection to permit the long flight. During the preflight, there was no convenient way of physically checking the tip tanks. Normally, I use the maintenance truck to climb on, but I don't remember one being in the vicinity during the inspection. At this point, there was no reason why I should have doubted that I did not have maximum fuel.

"During the passenger briefing, I pointed out the door jettisons for the rear doors and cautioned the passengers to only use them in an emergency. The parachutes were draped over the seats with the straps so arranged that they could get into them easily. I told them we would be flying at 6,000 feet and would have enough time, if necessary, to slip them on. I told them a little about the glide characteristics of the U-6 and told them it could glide long enough to get ready for a jump. I also pointed out that the U-6 could be landed relatively safe even in the trees . . . I reminded them to fasten their seat belts during takeoffs and landings and told them to get as comfortable as possible once we reached altitude.

"I started on the rear tank, taxied on center, and ran up and took off on the front tank. I don't know exactly how much I had used out of the front tank — the gauge showed about 6-8 gallons remaining — when I switched to the rear and began transfer. I filled up the front tank and switched back to it. For my second fuel transfer, I repeated the sequence, noticing two irregularities: 1. I transferred fuel sooner than I was accustomed to, and 2. when I transferred the second time, the right wing seemed a little heavy, so I assumed that something may be interfering with the right tip tank transfer. I recycled my transfer valve and put it on 'R' for about 10-15 minutes before I put it back to BOTH. Because of this, I left the fuel transfer on for an exceptionally long time and this caused me to switch from the rear tank to the center. I did not exhaust the rear tank at that time, but the gauge — which I

don't normally trust anyway — showed the rear tank was getting low. I switched to the center tank and it seemed the gauge moved down the scale too fast . . . . I turned back to the rear tank to use all of it, watching the gauge. As it approached zero, the fuel pressure light came on and I immediately switched to the center tank.

"Wanting a margin of safety, I decided to land earlier than my original destination, if possible. I checked the weather along my route, but found the reports zero-zero. Even the stations I had passed over were down. The station I was over reported zero-zero. Passing over it, all I could see was a glow as the high intensity flashers lighted up the overcast below me . . . . Checking the route between where I was and my original destination, I could find nowhere suitable to land. There were no IFR fields.

"I noticed that another town was approximately 20 minutes closer and asked the center for a change in destination. I requested and received a direct flight to the town. The controller had me on radar and gave me a 10° change in direction to avoid a restricted area . . . .

"Shortly, the center told me I was 60 miles from the town I was headed for and 50 miles from another town. They gave me the weather for the other town, which was not very good, but acceptable . . . . I was calculating my fuel estimate and asked for a slight delay to make my decision about where I wanted to go. I believe I told them that I would be unable to reach either of the towns and that I wanted clearance to a nearer airfield. I had roughly estimated 20-25 minutes of fuel remaining. The gauges indicated about 12 gallons.

"I received clearance to the airfield and asked for radar assistance and cruise clearance, which I received. I also asked for the distance, then switched to the airfield tower frequency. The tower operator repeated the clearance I had received from the center.

"I continued toward the VOR as I reviewed the approach procedure. I was advised that the ADF approach was more accurate than the VOR. I used both. I was also advised that the crash equipment would be standing by. I acknowledged. We both understood that this was going to be an emergency approach.

"In selecting the airfield, I had hoped that the obscuration would be thin and that, even though the visibility was one-quarter mile laterally, I might have better visibility vertically, which would enable me to use the runway lights as a visual reference.

"I arrived over the VOR at approximately 3,000 feet, descending. Because I felt I had only enough fuel for one approach, I wanted to be just right, so I modified my approach by putting the procedure

From experience, I knew that an 18-19 hour day does not fatigue me too much . . . I went to bed early so I could get a couple of hours of sleep

turn inside the VOR. This would put me within gliding range and possibly permit a look at the airfield. But there was nothing to see. The overcast appeared too thick.

"My instruments indicated a near perfect approach, both on VOR and ADF. I reached my minimum and saw nothing. I eased down to about 550 feet indicated and held that all the way to the NDB. I saw the light which I could not identify with the airfield. I told the tower that I would try an approach to the north.

"When I reached the NDB, I climbed, turning first to the right and then to the left. As I turned to the north approach, I realized I had turned back toward the NDB too early and too high. Descending then would have put me in a dangerous maneuvering area. So I did not descend, but remained above the fog, and moved across the airfield to the north to make another approach to the south.

"This time, determined to go to absolute minimums, I turned inbound when I received the fan marker. The ADF was my primary navaid this time. The VOR was on also. I indicated a slight drift to the left and the tower told me I was east. My time was at missed approach. Knowing I was near the tower, I delayed the correction to the right, then corrected only 10°-15°. My altitude was barely above 385 feet.

"I heard the tower tell me, 'Pull up.' Then I could see a row of lights directly below, but at too great an angle. I could not believe that they were the runway lights, as they did not agree with my heading nor instrument indications. Since I had no other choice, I decided to break right and reverse direction to the left and land. I kept the turn tight, climbing about 100 feet. I was warned about a 500-foot hill. Before I could reverse direction, I got the last fuel warning light.

"Rather than taking a chance of impacting in a turn, I shallowed the bank, slowed the airspeed, and decided to land in a three-point attitude on whatever it was going to be. Maintaining control seemed very important. Shoulder harnesses were locked and the passengers put cushions in front of them. I told them to hold on. The first thing I saw was a tree at my left front. I barely missed it with the cockpit as I pulled back for a roundout. I was knocked unconscious and came to during the rescue operation."

Question: "If you had not put the copilot on your 175, do you think the operations people would have accepted your flight plan?"

Answer: "There may have been some discussion about it."

Q: "Do you think your flight might have been cancelled?"

A: "I don't think so . . . I would have gotten another reading on the weather and if I was actually confronted with the possibility of going or not going, there are a couple of things I could have done. I could have waited a little bit longer until the weather got better, or rechecked the weather, more or less getting assurance that we would be on top all of the way, and, possibly, if I had to, I could have convinced the operations personnel that the regulation was remiss in that respect. But this didn't even enter my mind at that time."

Q: "When you put this officer on your 175 as copilot, did you know you were putting him there as copilot?"

The weather forecast indicated that the front which concerned me earlier had dissipated and only low stratus remained. After checking the weather again, I selected a destination 474 nautical miles away . . .

A: "Right."

Q: "And the purpose you put him there as co-pilot, was it to avoid any questions with the operations personnel?"

A: "Partially."

Nonrated copilot: ". . . The first time I became aware anything was wrong was when the pilot told the air route traffic control center he was having a little fuel problem. I believe this was when he reported over an en route station. He asked for vectors and weather at different airports and asked for a change of flight plan to another field. I don't remember the name. He talked to the tower at the field and asked what their conditions were. The tower operator said he could just see the runway lights. The pilot asked if they had high intensity lighting and the tower operator said no.

"We flew over the field, but were only able to see the lights twice, and just for a short time. The tower operator said we were east of the field.

"The pilot was awfully busy, but I asked him if I could wake up the men in the rear. He said yes, so I woke them and told them to strap in tight and to put the seat pillows in front of their faces if we had to go down. About then, the red light on the pilot's side of the panel came on and he told the tower we were out of gas.

"I leaned around and told the boys in the back to bend over and put the seat pillows in front of their faces. I gave mine to the boy just behind me. As I swung around, I saw trees through the haze just ahead of us and then we hit. I was apparently out for a short while, because the next thing I remember was the rescue people pulling me out through the front windshield and putting me in an ambulance for the ride to the hospital."

A LITTLE FUEL PROBLEM

The pilot never considered turning back . . . he listed a nonrated officer as copilot so that he would not be questioned by the operations dispatcher.

Aircraft accident investigation board: ". . . The aircraft first struck a 3-inch pine tree 13 feet above the ground, probably with the fuselage. The second tree strike was also 13 feet above the ground, approximately 12 feet further along the flight path and this strike was also probably on the fuselage. The most significant tree strike was on a 12-inch diameter red oak tree which was damaged from 11 feet to 16 feet above the ground. This strike tore off the left wing, strut, and left main landing gear. The aircraft then struck a 5-inch pine 4 feet above the ground and scarred a 6-inch pine from 5 feet to 12 feet above the ground. It came to rest on its left side and the rear fuselage was bent around, resting against a 6-inch red oak. The right wing was broken upward at the attaching points and resting against another red oak. The engine had broken loose and was lying ahead of the fuselage . . . .

"Examination of the fuel cells revealed approximately one cup of fuel in the rear and front tanks, slightly more than a quart in the center tank, and both tip tanks were dry.

"The mixture control was full rich, the propeller control was on full increase rpm, and the throttle was open to about one-fourth of the quadrant. All switches were on, except for the cabin light and flight instrument switches. All circuit breakers were in, except for the low fuel pressure warning light. The flaps were full down and there was no indication of control malfunction.

"The VOR course selector was set on 150° and the aircraft came to rest 1,000 feet to the east of the airfield runway . . . .

". . . The nonrated copilot agreed with the pilot's statement concerning the flight activities, but stated that when the pilot asked the tower operator about the weather, the tower operator replied that he could just barely see the runway lights . . . .

"The passenger who was in the right center passenger seat said that he had been told the aircraft was going all the way on the intended 2,500-mile flight, and that he had taken a sleeping pill just prior to takeoff and slept through the entire flight until he was awakened by the copilot yelling, 'We're out of fuel. Brace yourself!' After the crash, this passenger was the only one able to leave the aircraft without assistance.

"The second passenger said that he had slept throughout the flight and had been awakened and told to grab a pillow just prior to impact.

"The third passenger had no recollection of the flight, except that he had been asleep and was awakened just prior to impact.

"The pilot, copilot, and two passengers sustained multiple abrasions. The aircraft was damaged beyond economical repair.

"After weighing each of the people aboard and the luggage that was on board, it was found that, with the 138 gallons of fuel aboard, the aircraft was 259 pounds over the allowable maximum gross weight. Deducting 10 gallons of fuel consumed during runup by the alert crew, and deducting 10 gallons of fuel for the pilot's start, taxi, and runup, the aircraft was 139 pounds over allowable maximum gross weight at takeoff.

"Since the pilot had indicated that he felt there was a fuel consumption problem, the carburetor was removed and checked. It was found to be mechanically normal and, since the pilot had noticed nothing unusual about the engine operation, and since engine failure was caused by fuel exhaustion, the board felt that the engine and carburetor were functioning normally.

"A check of the aircraft logbook indicated there had only been 70 gallons of fuel aboard at takeoff. However, by interviewing members of the alert crew who had personally checked the aircraft, and by the pilot's statement regarding normal transfer of fuel, the board determined that the aircraft had a full load of fuel at takeoff, with the exception of the fuel used during ground time prior to takeoff.

"A review of the aircraft maintenance records for

the previous 6 months revealed no significant maintenance history.

"A check of the weather forecast for the flight showed that the actual weather along the flight route was either as forecast or better . . . .

"The pilot stated that his initial arrival at the airfield VOR was at 3,000 feet MSL on a VOR no. 2 approach, and, instead of turning outbound for a procedure turn, he continued his descent inbound in an attempt to see down through the fog and locate the airfield visually. When this was unsuccessful, he turned back toward the VOR, paralleling the inbound course. As he came approximately abreast of the VOR, he turned back to the inbound course, never getting a definite low station passage, and continued toward the airfield on final. He descended to 550 feet MSL, or slightly lower, and executed a missed approach after flying the prescribed time.

"He then notified the tower that he would make an ADF no. 1 approach. He turned slightly to the right to make a teardrop and turned back to the inbound course before reaching the fan marker inbound fix. He had climbed to an altitude of approximately 1,000 feet and arrived over the NDB at that altitude. At that time, he abandoned the approach and proceeded to turn slightly to the right in a teardrop pattern to make another attempt at a VOR no. 2 approach.

"He set the course selector on 150° and again turned inbound without receiving a definite low station passage. This time, he descended to an indicated altitude of slightly over 385 feet MSL, determined to make a landing. On this approach, he saw the airfield rotating beacon off his right wing and the lights on the parking ramp on his left. Incorrectly identifying the parking ramp lights as the runway, he made a 180° turn to the left, intending to land. The engine stopped before the turn was completed, so he rolled the wings level and crashed.

"An examination of the ARs governing the conduct of this flight revealed the following violations:

"AR 95-1 (para 28(3)b*3*). The pilot failed to require the passengers to wear available parachutes during a night flight under instrument weather conditions.

"AR 95-2 (para 20d). The pilot attempted three instrument approaches to an airfield which was reporting weather below published approach minimums, without declaring an emergency.

"AR 95-2 (para 23). The pilot took off on an instrument flight plan into known and forecast instrument weather conditions without a rated (Army aviator) copilot.

"AR 95-16 (para 2d(2) and 2e). The pilot took off with an overgross weight condition without filing a DD Form 365F.

Only the pilot wore a helmet and this was with the chin strap unfastened . . . this resulted in head injuries which could have been fatal.

A LITTLE FUEL PROBLEM

When the pilot was attempting the approaches, he evidently set his VOR course selector at 150°, although the inbound course was 154°. This mistake, and the existing visibility, created an impossible landing situation.

"Since the immediate cause of this accident was fuel exhaustion, the board attempted to determine if the flight could have been successfully completed if the pilot had not diverted. Data was not available to determine the performance of a U-6A over maximum allowable gross weight. However, the following figures were computed for the flight at a gross weight of 5,100 pounds.

Total usable fuel	138 gal
Fuel used in start, taxi, runup, and takeoff	10 gal
Fuel required for climb to 6,000 feet MSL in 52 minutes at 25.6 gph	22.4 gal
Fuel required for 4 hours and 54 minutes at cruise (6,000 MSL) 21.8 gph	89.3 gal
Fuel required for 30-minute reserve	10.9 gal
Total fuel required	132.6 gal

"It is apparent that if a 10-gallon fuel allowance is made for start, warmup, runup, and taxiing by the alert crew, this flight could have been successfully completed with approximately 7.3 gallons of fuel remaining. The total time required would have been 4 hours and 52 minutes. The board believed that with allowances for a non-standard day, excessive gross weight, nonexistent fuel management technique, unknown leaning procedures, and high fuel consumption during the attempted approaches, fuel exhaustion occurred at the time it should have.

"A study was conducted of the transcripts of the tapes made by air route traffic control centers and the tower tape from the airfield where the approaches were attempted. These showed that the aircraft reached cruising altitude approximately 52 minutes after takeoff. The flight progressed without incident until approximately 0422 when the pilot started requesting weather reports for various locations . . . .

"At 0458, the pilot reported he was having a fuel consumption problem. At 0502, he requested weather for a place closer than his destination. He then left the frequency to talk to the airfield tower. At 0509, he was advised that another location was reporting 700 feet overcast, visibility 8 miles. He then said he would proceed to that location.

"At 0514, the pilot was informed that a location 50 nautical miles away was reporting sky partially obscured, 800 feet broken, with visibility 1½ miles in fog. He was informed that radar showed him 50 nautical miles from that location, 60 nautical miles from his new destination, and 20 nautical miles from the airfield where he attempted the approaches. With his decision to attempt a landing at the airfield under existing weather conditions, the accident became inevitable. It was noted by the board that the pilot at no time declared or implied that an emergency situation existed.

"*Analysis:*

"Inspections were considered a contributing factor as the pilot failed to perform an adequate preflight. He did not physically check the level of fuel in all tanks. Therefore, he never really knew how much fuel he had on board.

Part 714.1, Aeronautical Communications and Pilot Services, FAA (instructions for FAA air traffic personnel): "Provide maximum assistance to aircraft in distress. Enlist the services of available radar facilities operated by the FAA, the military, and the Federal Communications Commission, as well as their emergency services and facilities, when the pilot requests or when you deem necessary."

A LITTLE FUEL PROBLEM

The only reason the investigation board could uncover for this flight was for the pilot to deliver presents to relatives at his destination

"Materiel failure, while not contributing to the accident cause, contributed to the injuries sustained by three occupants. The floor under the copilot's seat failed, allowing the seat to tip forward on impact.

". . . It was noted by the board that there were no scales available at the departure operations with which to weigh passengers and baggage. However, since the pilot was not aware of U-6A weight limitations, it is doubtful he would have used the scales if available.

"The pilot knowingly violated Army regulations by listing a nonrated copilot on DD Form 175.

"He failed to require his passengers to wear their parachutes and, in fact, never considered evacuating the aircraft, even when he had failed to complete an instrument approach under zero-zero conditions and fuel exhaustion was imminent.

"The pilot failed to compute fuel consumption and time of fuel exhaustion. By not declaring an emergency when it became apparent to him that he would be unable to safely reach his destination, the pilot did not use all of the facilities available to him. He failed to be concerned about the passengers' safety, even when he had been unable to complete three approaches and fuel exhaustion was imminent, until the nonrated copilot reminded him that the passengers were asleep and had their seat belts unfastened . . . .

"The board concluded that this accident was the culmination of a series of errors committed by the pilot due to his haste and strong desire to get to his destination. Although the pilot stated that he planned to RON when he became tired, none of the passengers understood this. They believed they were going to fly all the way, stopping only for fuel, and that the flight would take 18-20 hours.

"His haste was indicated by the fact that he forgot his suit, the only clothing he carried other than his flight suit, his hurried and incomplete preflight procedures, and his very slow climb to altitude with high airspeed. His strong desire also showed up when he realized he was running low on fuel and requested weather at various stations, all ahead of him. He never considered turning back. Strong desire was also apparent when he listed a nonrated officer as copilot so that he would not be questioned by the operations dispatcher. The nonrated officer had never attended a flight course, neither in military service nor civilian schools. He was not a pilot, yet the pilot felt that he fulfilled the requirements of a copilot because he could tune the UHF radio.

"The only reason the board could uncover for this flight was for the pilot to deliver presents to relatives at his destination. When he was attempting the approaches, he evidently set his VOR course selector on 150°, although the inbound course was 154°. This accounts for his constant arrivals east of the field. The board found it hard to believe that a pilot with his qualifications (special instrument rating and more than 2,500 flying hours) would attempt an instrument approach under such adverse conditions, knowing that the on-course signal is 1° wide (at 3.9 nautical miles, approximately 300 feet), and the allowable error in the receiver is plus or minus 4°, which would increase the margin of error to 1,500 feet. These allowable errors, coupled with the mistake in the course selector setting of 4°, and the existing visibility, created an impossible landing situation. The pilot's disregard for the safety of his passengers is inexcusable. If it had not been for the nonrated copilot alerting the passengers at the last minute, there most likely would have been serious injuries since they were all asleep with their safety belts unbuckled . . . ."

Flight surgeon: ". . . Proper flight uniforms were not worn by the passengers. Only the pilot wore a helmet and this was with the chin strap unfastened. Improper wearing of the helmet resulted in head injuries to the pilot which could have been fatal. Also, the pilot did not wear his flight gloves.

"Because of the impact of the crash, only one passenger was able to leave the aircraft by himself. The others were apparently pinned in the wreckage and had to be extracted by the crash crew . . . ."

"*Recommendations:*

"That the pilot receive a postaccident evaluation check.

"That the facts and circumstances of this accident receive Army-wide dissemination with emphasis on planning, preflight, weight and balance, fuel consumption, fuel management, facilities available under emergency conditions, and passenger safety.

"That a study be conducted to determine the feasibility of attaching seat belts to the floor of the aircraft to prevent occupants being thrown about, even though a seat failure occurs.

"That scales be issued to all airfield operations offices for weighing passengers and baggage."

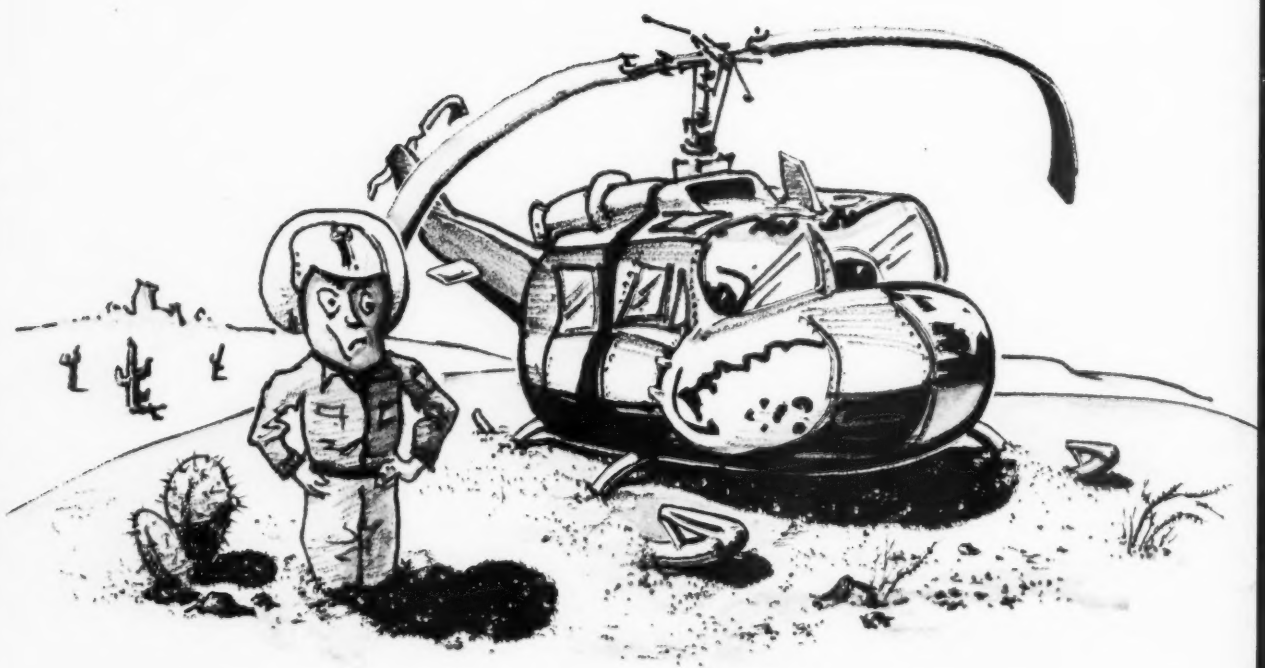
Reviewing official: "Concur with the findings and recommendations of the aircraft accident investigation board.

"As the result of a collateral investigation, the pilot was placed before a flying evaluation board. He will receive a postaccident flight check if returned to flight status . . . ."

Major Francis J. Toner

227th Aviation Battalion
1st Cavalry Division (Airmobile)

AIRCRAFT OPERATIONS in areas with large quantities of sand and loose soil create unusual difficulties for aircrews and maintenance personnel. Like those peculiar to any nonstandard environment, these problems require adjustments in procedures and an understanding of the reasons for such changes. Successful continuous operations require a spirit of teamwork and cooperation between flight and maintenance personnel.



Operations in Sandy Areas

Basically, rotary wing operations in locales where large amounts of dust and sand are present will result in reduced aircraft efficiency and increased maintenance on airframes and components. From the aviator's viewpoint, takeoffs and landing approaches cause the largest areas of difficulty. Visibility can, and frequently does, approach the near zero point during these maneuvers. In addition, dust and debris generated by the rotor downwash can clog intake filters and reduce engine efficiency.

Under circumstances where aviators know that sand and dust exist in landing or takeoff areas, special techniques can be used to lessen likely adverse effects. First, all approaches should be made directly to the ground, without terminating at a hover. This type approach will naturally reduce the time during which dust clouds can be generated. Similarly, takeoffs should be made from the ground, without coming to a hover, to reduce total dust and sand disturbance. Second, ground operation time should be limited to that required for normal runup and shutdown procedures. Extended engine operation on the ground will result in unnecessary ingestion of sand, dust, and debris into engines and other moving components. The most damaging aspect of operating in sandy environments is the unfavorable effect on airframes and moving parts. All exposed surfaces are continuously sand blasted and eroded; bearings can literally be destroyed; plexiglass becomes crazed; instruments can be made unreliable; and even radio operation can be impaired.

In general, the most satisfactory way to reduce maintenance difficulties during operations in sandy areas is stress repetitive inspections, detection, cleanliness, and use of protective covers provided with helicopters. Aircraft must be under constant scrutiny when they are on the ground. Crewchiefs, line chiefs, and technical inspectors must use every opportunity to inspect and evaluate their aircraft. Crewchiefs should make extensive efforts to ensure that areas where sand can collect are kept free of dust and dirt. Areas such as engine decks, cowling-covered components, and places where oil and grease can be expected are especially inspected. Filters of all types must be inspected and cleaned frequently. Air intake filters, fuel and oil filters, and instrument filters will all collect dust and dirt rapidly. Constant cleaning can ensure trouble-free operation and significantly extend the operating life of all components.

As indicated, standard protective covers are available for all helicopters. These covers are used for pitot tubes, engine intakes, engine exhausts, as well as in some cases for rotor blades, hub assemblies, and windshields. Under normal conditions, this equipment is put on the aircraft at the end of each operating day, or when especially adverse weather is expected. When operating in dusty or sandy conditions, however, these protective covers *must be put on the aircraft after each flight.*

Although Army turbine engines, with their centrifugal stages, are designed for satisfactory engine operation in sandy areas, such operations do erode compressor blades, inlet guide vanes, and reduce engine life. Maintenance personnel can do little to reduce these undesirable results. Similarly, crewchiefs and maintenance personnel find it difficult to prevent erosion of main rotor and tail rotor blades. However, when operations are conducted under these conditions, maintenance personnel must be extremely vigilant in detecting all types of blade deterioration. Such deterioration will take place at a rapid rate under continuous operation in sandy areas, and few blades can be expected to last until TBO time under these conditions.

With respect to bearing surfaces, maintenance personnel can play a vital role in protecting parts and increasing operating life. All bearing and pitch change links must be inspected daily, or more often when possible. Lubricated bearings should be purged daily to remove sand and other abrasives.

Radios can also be affected by sand and dust. Even though radio repair of this type is not usually an organizational mission, it is helpful to know the cause of such difficulties. On the RT/ARC-54 radio, for instance, there have been numerous instances of clogged filters in the power amplifier section causing radio malfunctions. Direct support units are capable of changing these filters and cleaning the caps in the amplifier section. Again, keeping radio and electronic compartments clean and free of dirt and grime can reduce problems with all types of radios and electrical equipment.

In summary, it can be said that rotary wing aircraft will continue to operate successfully in sandy and dusty environments. These operations will continue to be considered *normal.* In order to conduct these operations safely and still maintain reasonable aircraft availability, constant attention must be paid to techniques and procedures designed to reduce the adverse effects of sand on the aircraft. This will require a unified effort on the part of aviators and maintenance personnel.

From USARV AVIATION PAMPHLET, April 1968

E. H. Flinn

Air Force Flight Dynamics Laboratory
Control Criteria Branch

Helicopter Rotorwash Effects

A NUMBER OF recent mishaps have been reported in which the rotorwash of helicopters was considered to be a possible factor. As a result of concern in this area, the Air Force Flight Dynamics Laboratory was requested by the USAF to study this problem area and provide information relative to the operation of fixed wing aircraft in the vicinity of helicopters.

Vortices which trail from the wing tips of any airplane in flight are quite powerful and can persist for several minutes after the passage of the aircraft (see fig. 1). The average velocity and the total energy of the rotorwash in the wake of a helicopter in forward flight are similar to those for an airplane of the same weight and span and flying at the same airspeed. At a distance of one to two rotor diameters downstream from the helicopter with forward speed, the vortices shed by the rotor tips roll up into a pair of vortex cores (fig. 2) which are similar to the vortices of conventional aircraft. In addition to the effects of rotorwash from a helicopter in forward flight, there are also problems associated with the downwash at or near hovering flight.

VORTEX SETTLING, SPREADING AND DECAY

Since each of the trailing vortices produces a downward movement, the vortices settle with time. If the vortices are generated more than a few rotor diameters above the ground, they tend to maintain a constant lateral spacing and have a constant downward velocity. As the vortices approach the ground to within two or three rotor diameters, their motion is slowed and they begin to spread apart laterally. When the vortices are generated closer to the ground, their initial vertical velocity is less. They tend to settle to a level somewhat closer to the ground and spread laterally at a faster rate than for the first case (fig. 3).

A wind of more than 5 knots, or convective action

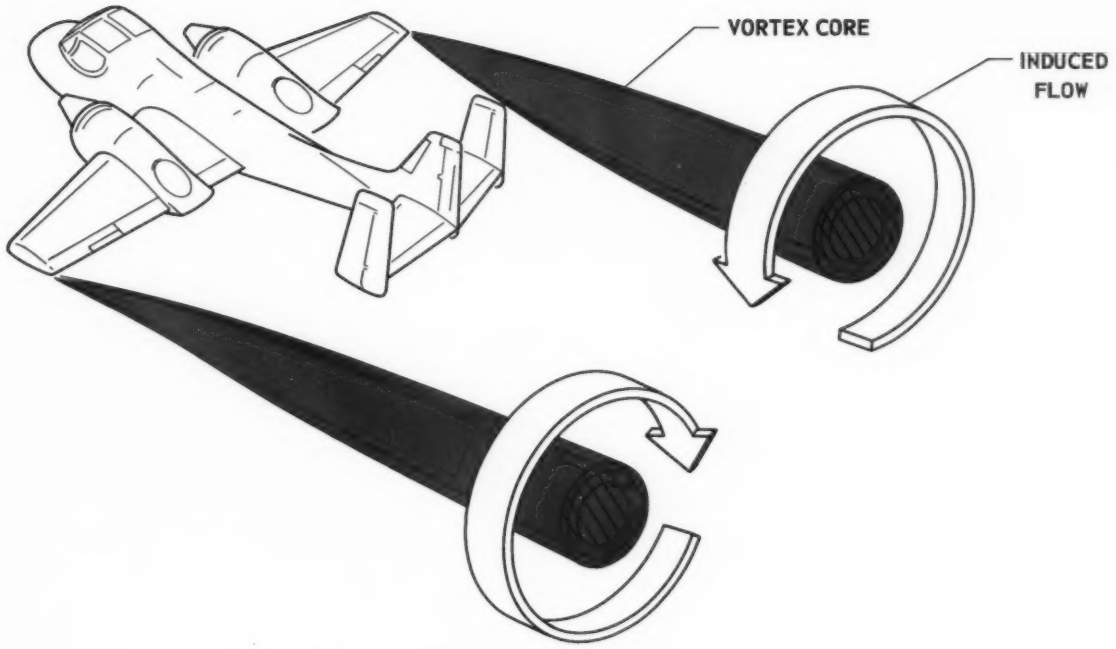


Figure 1. Illustration of trailing vortex wake behind a conventional aircraft.

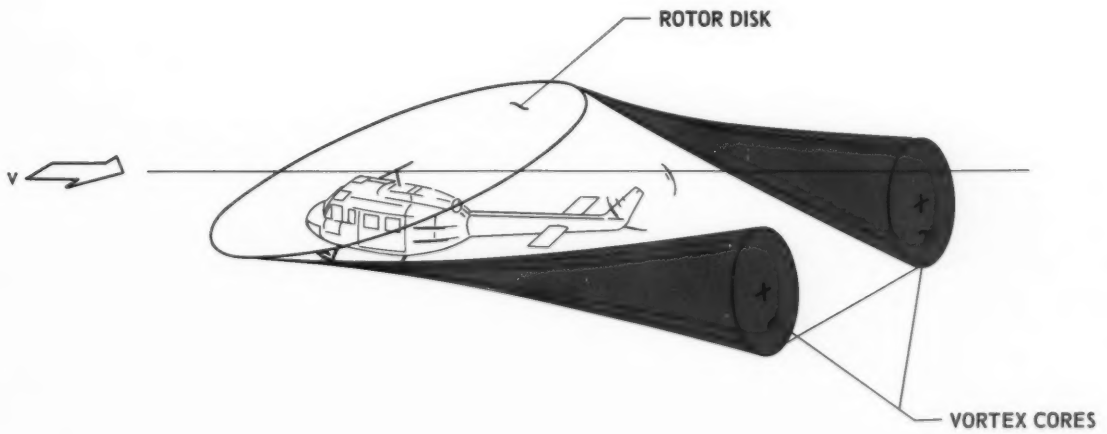


Figure 2. Illustration of the helicopter wake showing how the vortices roll up at the tips and expand downstream.

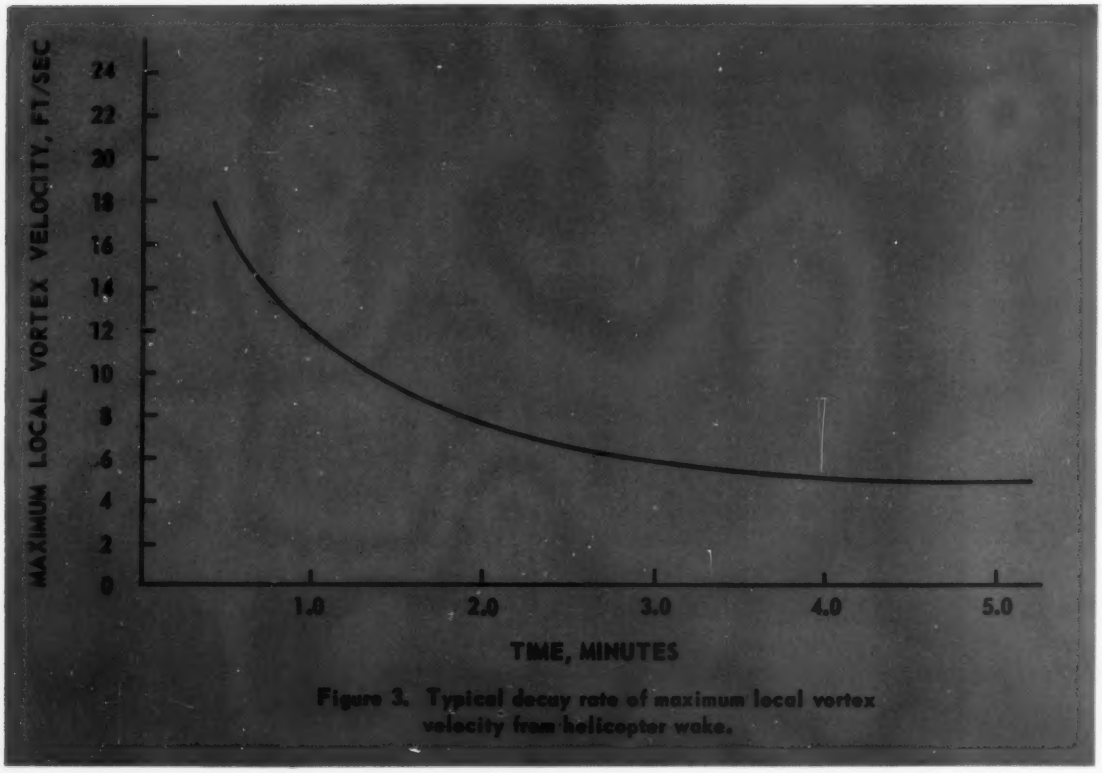


Figure 3. Typical decay rate of maximum local vortex velocity from helicopter wake.

due to heating, would be accompanied by atmospheric turbulence, particularly at the lower altitudes, which would tend to cause more rapid decay or complete disruption of vortices. Where the vortices are close to the ground, frictional forces between the ground and the vortex-induced airflow would contribute to vortex decay. Although pilots have reported apparent encounters with trailing vortices at separation times estimated at 5 minutes or more, no actual measurements of vortex intensities have been recorded for separation times greater than 3 minutes. The factors which determine the time of this final dissipation of the vortices, however, are not known.

EFFECTS ON AIRCRAFT PENETRATING TRAILING VORTICES IN FLIGHT

There are three modes of penetration of the trailing vortices of a helicopter which will have distinctly different effects on the penetrating aircraft. These modes are cross-track, along-track between vortices, and along-track through the vortex center.

The first mode of penetration, cross-track, would most likely occur during flight in a traffic pattern in the vicinity of an airport. This type of vortex encounter would tend to cause pitching and vertical motions and produce loads on the penetrating aircraft in a fashion similar to that of flight through gusts.

Vertical loads encountered in this mode will be a function of time and the ratio of gross weight of the penetrating aircraft to the helicopter generating the vortex. The instinctive control reaction by pilots to this type of disturbance in light aircraft could cause a substantial increase in loads, to the extent that the ultimate load could be exceeded. However, since the strength of the vortex is decreasing rapidly with time, little danger of structural damage to light aircraft would occur with separation times greater than 1 minute.

Large aircraft have, in general, slower response to controls in contrast to light aircraft and would not experience much increase in load due to pilot reaction. Thus, the conditions under which this mode can be dangerous appear to be largely limited to the case of light planes crossing the wake of a larger aircraft within about a minute after the passage of the larger aircraft.

The second mode of penetration, along-track between vortices, would most likely occur during takeoff, climbout, landing approach, or formation flying. In this mode, a downward flow would act on the penetrating aircraft and cause it to settle, or at least reduce its rate of climb. This effect would diminish quite rapidly as the penetrating aircraft is forced below the plane of the vortices. However, at very low altitudes it could be very dangerous with the airplane striking the ground before a recovery could be made. A greater hazard in this case is the possibility of the pilot stalling the aircraft in an effort to check the settling tendency. This particular vortex effect can persist up to 2 minutes after passage of the generating helicopter.

As pointed out earlier, the vortices stop settling and begin to spread laterally near the ground. Winds can thus have a significant effect on the location of the vortex with respect to takeoff and landing situations. Headwinds move the vortices back toward the takeoff point. However, the lateral displacement tends to lessen the effects on a penetrating aircraft. Cross-

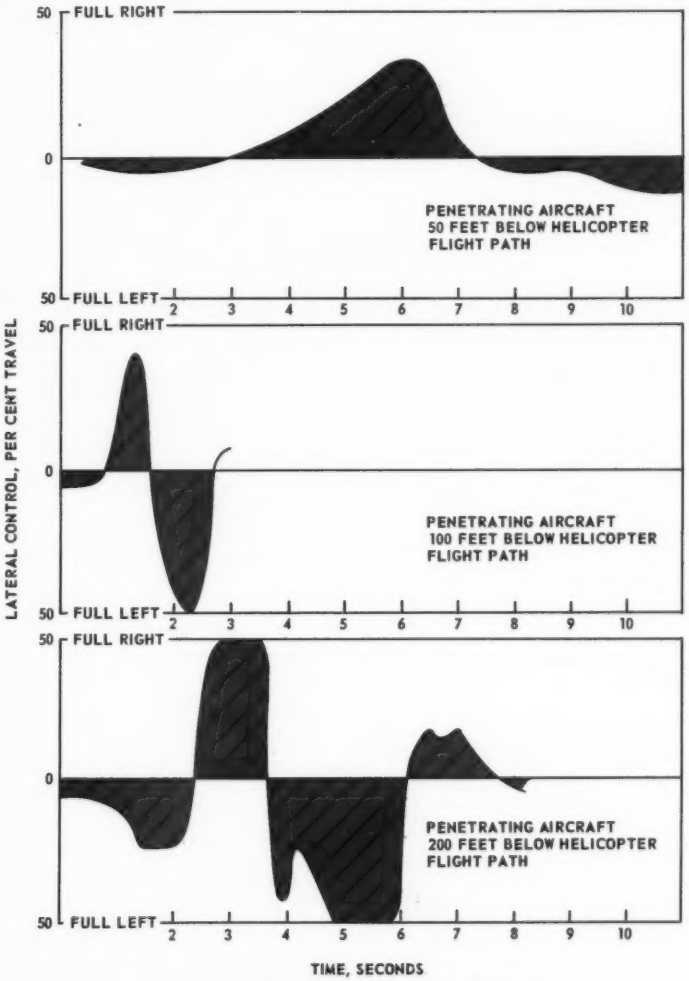


Figure 4. Pilot induced lateral control after initial penetration of helicopter vortex.

...the lateral upsets encountered would be very dangerous if they occurred near the ground...

winds, especially if light, are generally considered to be most detrimental. If the crosswind speed is equal to the lateral speed of the vortex, this vortex can remain in a fixed position, above or on the runway, until it is dissipated, causing very serious takeoff and landing problems. In general, light crosswinds tend to increase vortex encounters close to the ground and decrease the chances of encounter at altitude.

The third mode of penetration, along-track through the vortex center, would most likely occur during takeoff, climbout, landing approach, or formation flying. This penetration mode is perhaps the most dangerous of the three modes. The penetrating aircraft would be subjected to a rotational flow which induces a rolling motion to the aircraft. The roll rate induced by the vortex is primarily dependent upon the vortex rotational velocity, time, and penetrating aircraft size. It is essentially independent of the speed of the penetrating aircraft. The rate of roll available from the penetrating aircraft's lateral controls, however, is proportional to speed. Thus, the degree of controllability of the penetrating aircraft will strongly depend upon the separation time between the generating aircraft and the penetrating aircraft, with the rolling decreasing quite rapidly with increasing separation time.

Substantial lateral upsets are indicated for this mode of penetration at separation times of less than 2 minutes, even for aircraft of equal weight. This could be very hazardous within 300 feet of the ground on a takeoff or landing, especially for light aircraft. Although the upset would tend to be smaller for a large and heavy penetrating aircraft, the extent of the upset that could be tolerated is also less because of its slower recovery time.

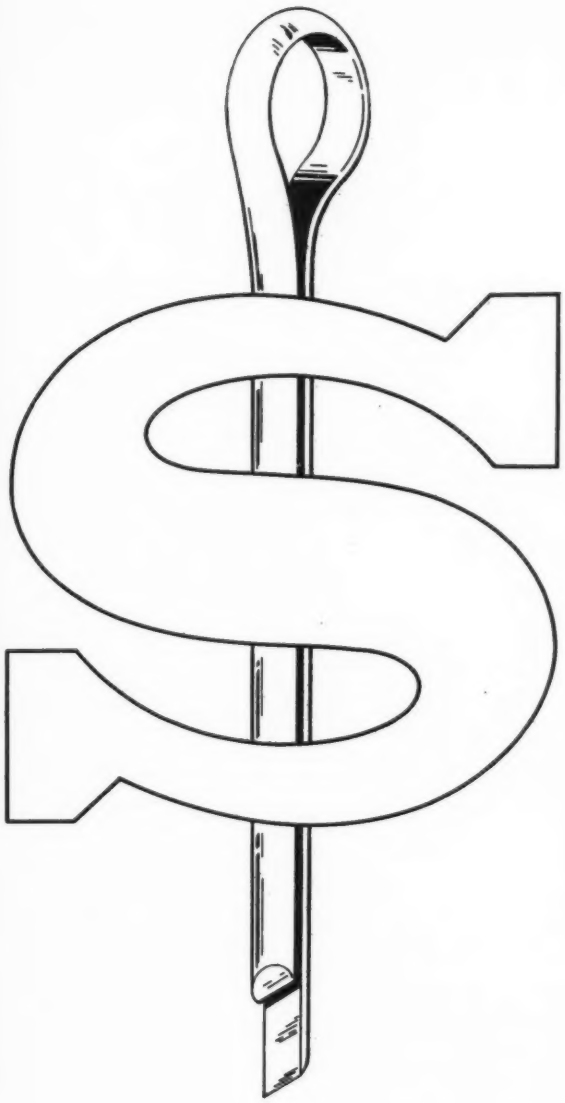
Figure 4 was extracted from a NASA report to graphically show the effects of penetrating the vortex wake behind a helicopter. During this test, a T-28 aircraft, having a nominal gross weight of 7,400 pounds and an airspeed of 80 knots, was flown at various distances below the flight path and approximately 1,000 feet behind a CH-34 helicopter having a nominal gross weight of 6,900 pounds and an airspeed of 40 knots. Time histories of the pilot's control inputs required to prevent lateral upset during the penetration are shown for distances of 50, 100 and 200 feet below the helicopter's flight path. In the last case, the pilot was required to use about 90 percent of the total available lateral control in less than one-half a second to maintain nearly level flight. A control input of this magnitude in calm air at the flight test conditions would result in a rate of roll of approximately 36° per second.

During these same tests, a landing approach penetration was simulated by a descent at 250 feet per minute on course through the wake, at 1,000 feet behind the helicopter. As the airplane entered the wake, a moderate but pronounced rolling occurred and the rate of descent was increased to 500 feet per minute. In summarizing this test program, the research pilot who flew the T-28 commented that the lateral control limits of the airplane were slightly exceeded and that the lateral upsets encountered would be very dangerous if they had occurred near the ground.

In general, helicopter wakes are similar to wakes of fixed wing aircraft, and it follows that operational problems associated with wake encounters are similar. The lower operating speeds of helicopters, however, can result in higher intensity wakes and consequently more severe wake encounters. Although it has been shown that a rotor wake vortex encounter in flight can be a real hazard, such an encounter requires that the penetrating aircraft be in a certain limited spatial region at a certain time, under suitable atmospheric conditions. Such a combination of circumstances apparently occurs infrequently, despite the frequency of high density traffic in terminal areas.

Exposure to the rotor wake vortex hazard, particularly in takeoff and landing operations, can be substantially reduced by suitable air traffic control procedures which emphasize appropriate sequencing and spacing of flight paths. Basically, the penetrating aircraft should be on or above the flight path of the vortex generating aircraft or have a separation time of at least 1-1½ minutes, if below the flight path of the vortex generating aircraft. The lighter the weight of the penetrating aircraft with respect to the generating aircraft, the more serious is the hazard to be expected. However, as a caution note, the vortex intensity of the helicopter rotor wake is a direct function of disk loading. Thus, helicopters with greater disk loadings will produce wakes of greater intensity at a given speed, regardless of size, and larger helicopters with the same disk loadings produce wakes enlarged only in size. As one final note, pilots flying light observation aircraft should take precautions with extra care, particularly when low and slow.

Although this report has not presented any details regarding problems associated with hovering helicopters, a brief review of the literature concerning helicopter downwash research indicates the following precautions for this type of operation should be noted. In general, helicopters should not be hovered closer than 1,000 feet upwind of an active runway, or operated at high thrust under no-wind conditions closer than three rotor diameters to other aircraft.



HOW MUCH FOR A COTTER PIN?

in this case, $251,740.00

CH-21C PILOT: ". . . After landing on a small snow-covered and frozen lake, I started the engine, engaged the rotors, and picked up to a hover. After the crewchief checked for clearance, I started a left turn to get more room for takeoff. At the time I started the turn, I estimate I was at a 4-5 foot hover.

"During the turn, I felt the aircraft starting to tip to the right. I applied left cyclic and right pedal. I then reduced power and tried applying right and left pedal, trying to get a response of any kind. I did not get any reaction, either increasing or decreasing the tipping action.

"The aircraft fell through on its right side. We got out after I shut off the switches and determined that no one was hurt."

The rotor blades were destroyed and there was major damage to the rotor heads, stabilizers, right cabin windows, right front windshield, and fuselage.

Aircraft accident investigation board: ". . . The possibility that the right ski had dug into the snow during the hovering turn was investigated. Statements from all crewmembers indicated a 3-5 foot hover with good visibility before the aircraft started tilting. The crewchief was looking out the cargo door during the turn and assured the pilot he was clear to the left rear.

"The pilot stated that he had experience with skis and at no time did the aircraft feel like the ski was digging into the snow. As soon as he felt the helicopter tilt, he tried to land. He reduced collective and corrected with left cyclic, but he felt no lurch or bump — only the smooth rolling motion of the aircraft and a complete lack of control response.

"The copilot said that when he first felt the aircraft tilt, he saw the pilot apply more and more left cyclic, with no response.

"Ski marks in the snow indicated that the aircraft was tipped over by the right ski digging into the snow. There were no marks of the left ski touching the snow. There was a definite gouge that showed where the right ski drug about 8 feet, then cut the crust of the snow at more than a 45° angle. This

How Much For A Cotter Pin?

contact of the ski and the angle of slicing into the deep snow would explain why the passengers and crew did not feel the contact until the helicopter rolled over. Investigation showed no failure or damage to the ski or attaching cables and bungee cords.

"The pilot and copilot were given postaccident checkrides to determine if improper techniques or dangerous habits had been a factor. However, safe and proper techniques were displayed in all maneuvers.

"During an inspection of the aft rotor head, a rotor control link assembly on the right side was found to be disconnected at the upper end. The link assembly was serviceable and undamaged. The lower end was still attached to the bellcrank. The left link had been stripped off the left trunnion by the impact and the complete shaft, nut, washers, and cotter pin were present. Close inspection of the right trunnion assembly revealed that a portion of the threaded shaft, to which the link assembly is attached, was broken off. The retaining nut, washers, cotter pin, and the portion of the threaded shaft from the cotter pin hole outward, were missing. The remaining threads on the shaft were in good condition . . . .

"The aft transmission, rotor head, and attaching controls were removed as a unit for inspection and photographs. Components of an identical unit, in operable condition, were assembled for comparison. With the retaining nut removed and the controls deflected to the maximum in all directions, the link could not be completely removed from the trunnion without first disconnecting the lower end. With the retaining nut completely removed, the link could be displaced outward on the trunnion shaft. The displacement of the right link allowed the gimble ring to tilt downward on the side that had the displaced link.

"The right trunnion assembly was submitted to a laboratory for analysis of the break. Analysis revealed that the break occurred from the type of lateral force that would occur at impact, and not during flight.

"Aircraft records showed the aft head had been installed 456:35 hours before. The last periodic inspection was performed 55:45 hours before, and an intermediate inspection only 06:35 hours before. Although normal maintenance was performed and a preflight accomplished before the flight, no one could state that they had specifically checked the control links.

"The part number that was stamped on the trunnion assembly installed on the right side indicated it was a left trunnion assembly. Inspection of an assembly with interchanged trunnions . . . proved that the trunnion assemblies could be interchanged and function normally. The only visible difference is the positioning of the grease fittings.

"Possibly, if the pilot had checked all of the controls for movement before starting the engine, he might have felt a bind or roughness, if the link had been displaced at that time. He would not have noticed any problem with the controls after the hydraulic system became operative. As he stated, the controls were still very smooth when the blades hit the snow. The control link evidently became displaced as the hovering turn was completed, before the takeoff was started. Then the control link became completely disconnected from the trunnion at the time of impact, when the tip of the shaft was broken off.

"The board felt that this displacement of the link caused a bind in the trunnion assemblies and this, in turn, caused the lack of control response. The tilt of the gimble ring was shown by the marks left on the slider assembly by the rotation of the trunnions when the blades struck the snow. Marks caused by the right trunnion assembly on the aft head were one-eighth of an inch lower than the left trunnion marks. This tilt caused the trunnion assemblies to bind in position and prevented collective control response. The marks showed that the pitch had not been reduced in the aft rotor head.

"The board considered the possibility that a foreign object had lodged in the controls and broken the trunnion shaft at the cotter pin hole. This theory was discounted because of the absence of scratches or damages on the gimble ring within access of the trunnion shaft. Results of the metal analysis showed that the break occurred laterally in a direction opposite to normal rotation.

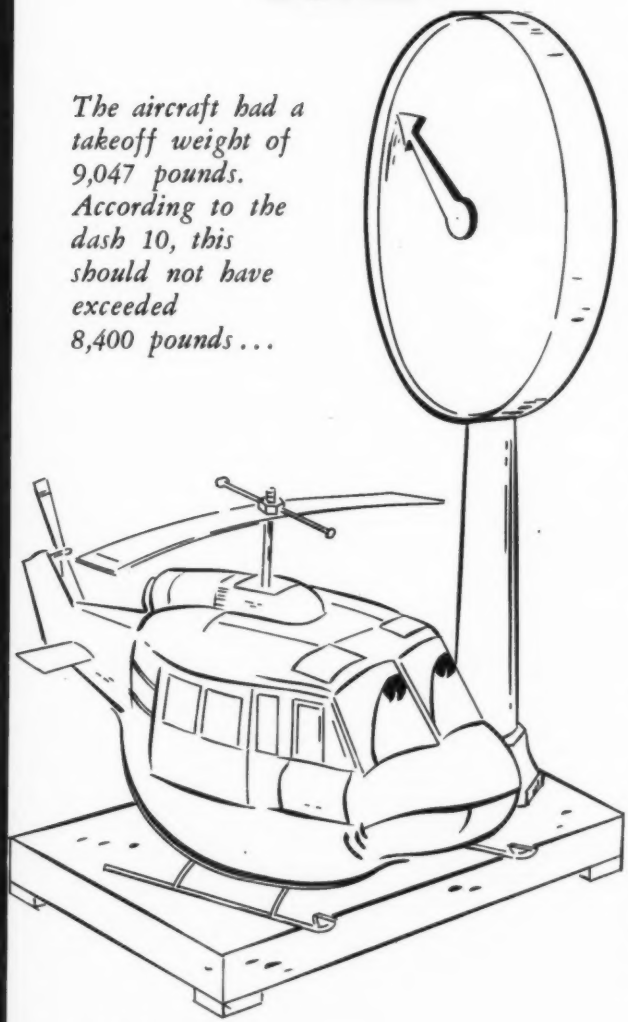
"The accident was caused by a loss of collective control which prevented recovery from the tilt caused by the right ski digging into the snow during a hovering turn. The turn was made around the center of the aircraft so that the skis swung toward an incline. The board was unable to determine if the low hover was caused by the loss of control or by the pilot. However, it is believed the pilot could have recovered from the tilt if the controls had responded normally.

"The reason the link became displaced was the absence of a cotter pin in the right trunnion shaft. This allowed the retaining nut to back off and the link to become displaced outward on the trunnion shaft, causing the trunnion assemblies to bind. The cotter pin was not installed or installed improperly so that vibrations could loosen it or wear it out."

How much for a cotter pin? In this case, $251,740.

GUESSTIMATED LOAD

The aircraft had a takeoff weight of 9,047 pounds. According to the dash 10, this should not have exceeded 8,400 pounds . . .



UH-1D PILOT: ". . . We loaded the aircraft with approximately 1,000 pounds of cargo and the crewchief and two passengers got aboard. I called the tower and received clearance for a takeoff to the west. I brought the aircraft to a hover and started to move forward when the rpm dropped from 6600 to 6200. I immediately put the aircraft on the ground.

"After regaining rpm and boosting it to 6700, I again brought the aircraft to a hover and started moving forward to the runway. The aircraft had not reached translational lift when the rpm dropped to 6100. I immediately started to slow the aircraft and bring it back to the ground. Then I felt a gust of wind directly from my rear and the skid heels hit the ground. I attempted to level the aircraft and bring it to a halt before running into the ditch alongside the runway. The tail started to the left and, as I applied full left pedal, it started to straighten out, but I lost all usable rpm. I then brought the pitch down to regain rpm and slow the aircraft. The skids separated and the aircraft moved 2 or 3 feet forward, coming to a stop upright.

"I called the tower and told them about the accident . . . The skids were separated and the chin bubble on the left side was broken . . .

"The tower had given me a forecast of winds from 260° at 10 knots. I checked the wind sock on the tower before takeoff and the wind appeared to be from the west. While walking to the operations office from the accident, I noticed that the wind sock was pointing south, indicating the wind was out of the north instead of the west."

Investigating officer: ". . . The pilot was questioned about the weight of his cargo and he gave an estimate of 1,000 pounds. The cargo, weighed after the accident, totalled 1,971 pounds, giving the aircraft a takeoff weight of 9,047 pounds. According to TM 55-1520-210-10, the takeoff weight should not have exceeded 8,400 pounds . . .

"The cause of this accident was failure to recognize a critical takeoff situation in time to abort safely. . . ."

Recommendations:

"All aviators be flight checked on takeoff abort and rpm bleedoff procedures during quarterly training flights.

"All supervisors should take an increased interest in load and weather conditions prior to assigning flights."

Closeout letter: ". . . It should be noted that boosting the rpm to 6700 prior to takeoff creates an engine overspeed condition as pitch is applied and N_1 exceeds 85 percent. This practice has detrimental effects on the engine and the increased rpm actually reduces rotor efficiency. Recommend emphasis be placed on adhering to aircraft operating limits—6600 rpm maximum allowable for continuous operation."

With full combat gear and a crew of five, the aircraft was . . .

Loaded for Test

UH-1B PILOT: "I took off for a second test flight. I had test flown the aircraft earlier that day for replacement of tail rotor control cables and for removal and reinstallation of the scissors and short shaft. I had not released the aircraft on the first test flight because of cyclic binding. I felt the binding was related to the force trim system, so I had the maintenance crew disconnect the lateral force trim. The second test flight was to determine if that had stopped the binding.

"A crewchief, two door gunners, and a maintenance observer were along on the flight. The aircraft had 1,000 pounds of fuel and a loaded M-21 system. The wind was from the southwest at 5-10 knots and the outside air temperature was 38° C.

"Prior to takeoff, I worked the cyclic through full travel and the controls felt normal. I left the LZ and flew to a sandbar in the middle of a river. I shot an approach to the sandbar and hovered for about 3 minutes, then took off to the southwest and again felt the cyclic binding slightly. I made a right 180° turn to downwind and started to set up a pattern to the same sandbar. I made a climbing 180° turn to final and rolled out at approximately 60 knots, at 100 feet, in a nose low attitude. I started to pull aft cyclic and the cyclic control felt sluggish. It had little effect on the attitude of the aircraft. I pulled collective until the rpm started to bleed, and continued holding aft cyclic. The aircraft continued to descend and hit in a nose low attitude, flipped over, and came to rest in about 3 feet of water.

"I was upside down under water when the aircraft stopped moving. I unfastened my seat belt and shoulder harness and crawled out the window in the pilot's door. The armor plating was in the rear position and I had no difficulty getting out. As I stood up, I saw one of the gunners climbing out the right cargo door and asked him if everyone got out all right. I don't recall his reply. I went around to the other side of the aircraft and saw the crewchief standing in front. The other gunner was pinned under water on his back and was trying to free himself. I grabbed him by the armpits and tried to pull him out. I then saw the observer pinned in the wreckage in front of the gunner. He couldn't free himself, but his head was above water, and he began to help the gunner get out.

"I wasn't sure how much time had elapsed but I knew he was running out of breath, so I grabbed a lung full of air, clamped his nose closed, and attempted to force air into his mouth. I don't know if I was successful or not, but we managed to pull him out and got him on his feet. I told the crewchief and gunners to go ashore, but they stayed to help free the observer.

"With the help of another man (I believe an EM who had been working on the south side of the river), we pried the wreckage from around his neck, allowing him to submerge and swim out. Everyone got in two boats which had come from shore and started back . . ."

The crewchief was not wearing a seat belt. He lost four teeth and his jaw was injured. Neither of the two gunners aboard were wearing seat belts. Both sustained facial cuts.

Investigating officer: "Investigation revealed no maintenance or materiel factors. This accident was pilot induced. He used poor judgment in attempting to test fly an aircraft with a full combat load and a crew of five . . . The pilot did not take into consideration the effects of high density altitude and 38° C temperature. The pilot did not consider loss of lift caused by steep turns and abrupt maneuvers. He showed poor judgment in making steep turns near the ground and was negligent in not insuring that the crew was wearing all available restraint systems.

"Pilots and crewmembers should be aware of the loads they are carrying and the effect of density altitude. Steep or abrupt maneuvers should not be attempted near the terrain, especially under conditions of high gross weight and high density altitude. Aircraft on test flight missions should be restricted to the minimum crew required to accomplish the mission, and all available restraint systems should be used at all times."

Pearl's

personal equipment and rescue/survival lowdown

SOME DO . . . SOME DON'T

HERE ARE SOME extracts from the accidents in this issue of Crash Sense:

"A Little Fuel Problem," flight surgeon: ". . . Only the pilot wore a helmet and this was with the chin strap unfastened. Improper wearing of the helmet resulted in head injuries to the pilot which could have been fatal. Also, the pilot did not wear his flight gloves . . . ."

"To Break The Monotony"— Question: "Did your helmet come off?"

Aircraft commander: "Yes."

Question: "Was your strap fastened?"

Aircraft commander: "No."

"Survival kits were not being worn by the aircraft commander and pilot, but were located under their seats. The survival equipment in this instance could

have been used, i.e., the radio to facilitate rapid location and pickup of AC and pilot."

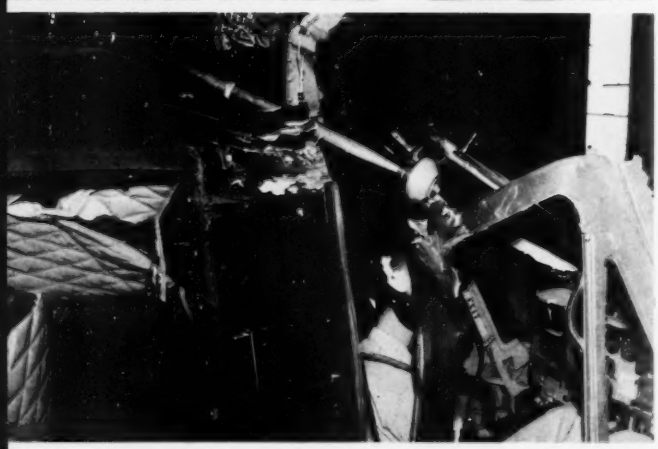
"Loaded For Test": "The crewchief was not wearing a seat belt. He lost four teeth and his jaw was injured. Neither of the two gunners aboard were wearing seat belts. Both sustained facial cuts."

HELMETS *DO* SAVE LIVES

Worn correctly, with chin straps fastened, your helmet can save your life. If you have any doubts about this, take a good close look at these photographs and remember them if you ever get the urge to leave your chin strap dangling.

One pilot sustained severe blows to head, but helmet saved his life. One blow (arrow) penetrated outer shell, but did not go through styrofoam liner

Both pilots aboard this mangled UH-1 lived to fly again



Investigator, wearing pilot's helmet, poses in cockpit of crashed UH-1 in which transmission and main rotor toppled forward at impact. Door was crushed in striking severe blow on back of pilot's helmet

Close up of helmet shows severity of blow which would have undoubtedly proven fatal without helmet

To Break The Monotony

the only reason given by the pilot for flying 15-25 feet above the river was to break the monotony

UH-1H AIRCRAFT COMMANDER: ". . . While flying a liaison mission, I was flying left seat as aircraft commander . . . We had five passengers, a crew of four, and approximately 1,100-1,200 pounds of fuel, for a gross of approximately 8,500 pounds. We flew low level along a road approximately 90° to the river, made a right turn, and proceeded downriver.

"I believe the ceiling was somewhere around 2,000 feet, with very light rainshowers. There was some wind across the river, with updrafts and downdrafts. We came over a hill and down when one of my passengers said he saw four black pajama-suited figures with weapons along the river bank on the

To Break The Monotony

Immaturity and limited experience were listed as probable or suspected cause factors when aircraft commander allowed passengers to persuade him to divert from mission for low level flight and abrupt maneuvers over river

east side. I went downriver a little further, made a left turn, and flew back up the river about 50 feet above the water and went past the spot where they were seen, climbed up to 250 feet over a ridge line, did a sharp left turn, lowered collective, and dived toward the river. While I was trying to pull out of the dive with power and aft cyclic, the aircraft apparently caught a downdraft and crashed in the river.

"After hitting the water, I found myself at the bottom of the river and I was caught on something that was holding my shirt and armored plate. Just as I was taking these off, a large portion of the helicopter fell on me. I pushed this out of the way without too much trouble and swam to the top . . ."

Question: "Why did you decide to fly low level?"

Answer: "To break the monotony."

Question: "Did your helmet come off?"

Answer: "Yes."

Question: "Was your strap fastened?"

Answer: "No."

Passenger: ". . . On the return trip we came to a river and flew downstream at about 15-25 feet above the water, leaving the river only once or twice where it narrowed or turned sharply, only to come back to the river. At one point, while flying low over the river, the AC made a sharp left turn, came back around, and passed low over the river in the same area. He then turned back to cover the area again.

"Only the crew and one passenger had headsets and the only reason I could think of for the extra passes was that something or someone had been seen in the area. It was on this third pass, coming back in over the river from the left side, heading downstream at about 50-75 mph, that the ship did not pull up in time. It struck the water at a sharp angle, nose first, and came to almost a complete stop on impact. The left side seemed to make contact with the water first.

"After impact, I released my seat belt and came out of the right side. I thought the ship was resting

on the bottom of the river, but it wasn't. I found a waterproof bag floating next to me, which I grabbed. I heard someone upstream call for help. He only called one time and I could not locate him. At this time, the ship sank and I was carried away by the strong current. I tried to work my way to the bank, but couldn't. I still had the waterproof bag, but had lost my M-16 and webbing. The current carried me near the left bank where I saw a small tree sticking out of the water. I was able to grab it and hang on by wrapping my legs around it.

"While hanging to the tree and resting, I heard someone cry for help. Holding the waterproof bag and the tree in one hand, I reached out as far as I could and told him to do the same, as the current was bringing him toward my position. I was able to get his hand and pull him to the tree with me. I told him we would rest and get our boots off before we made another try for the bank. He said he couldn't make it by himself. I told him we would make it together with the help of the waterproof bag . . .

"We took off our boots and hung them around our necks. The waterproof bag was still in good shape, so we made another try for the left bank. We could not get to the bank, but were swept to the right side of the river by the current . . . I told him the waterproof bag was going down and I couldn't make it with him without the bag. We were washed over a large rock and fell a few feet into a pool. When we came up, the current wasn't as strong at that spot and the other man made it to a large rock in the river. The current carried me close to the bank, which I made with a little effort. The man from the rock called and said he was going to lie down and not to worry about him, that he was okay . . .

"I opened the waterproof bag to see what help the contents might give. The only items I thought might be of later value were the bag, a white towel, and shower shoes. The shoes might have helped take the place of my boots which I'd lost when we went over the big rock. I tossed the items of no real value that would float into the river, hoping they might help rescuers find us.

"I then started to dry my lighter and got some dry grass to start a fire. I had been working on the bank for about a half hour when I heard aircraft upstream. I started my fire and fanned it with the towel. We were spotted by one of the aircraft. A short time later a rescue aircraft was above us. They dropped a line to the other man, then to me . . ."

The aircraft and the crewchief, gunner, and three passengers were not recovered. The pilot and one passenger sustained major injuries, and the aircraft commander and one passenger had minor injuries.

Aircraft accident investigation board: ". . . It was determined that the aircraft, at an altitude of 250 feet and an airspeed below 40 knots, made a sharp left turn, entered a dive, and struck the water in a nose low attitude at an airspeed of 60-80 knots, with engine rpm deteriorating below 6200 . . .

"The board determined that weather was not a factor in the accident. It further determined that weight and balance was not a factor. The aircraft appeared to the crew to be operating normally, which indicates there were no mechanical failures."

Established cause factors:

"1. Failure to initiate recovery from dive in sufficient time.

"2. Electing to conduct unnecessary low level flight.

"3. Diverting from primary mission."

Probable or suspected cause factors:

"1. Relative immaturity and limited experience of the aircraft commander.

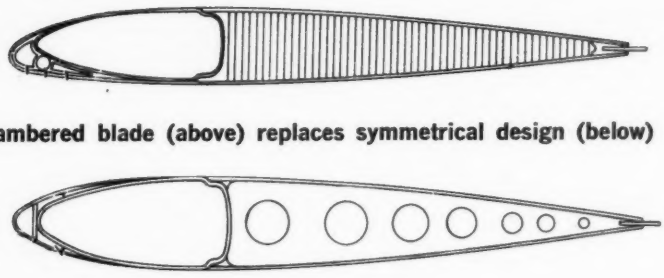
"2. Possibility that, during the dive, the aircraft commander's attention was diverted to the area of interest on his left.

"3. Decision to divert from primary mission was too easily influenced by crew and passengers."

Nonrelated factor: "Survival kits were not being worn by the aircraft commander and pilot, but were located under their seats. The survival equipment in this instance could have been used, i.e., the radio to facilitate rapid location and pickup of AC and pilot."

Ray Spears

Mr. Spears is employed by the Boeing Company, Vertol Division, Morton, Penn.



Cambered blade (above) replaces symmetrical design (below)

New Chinook Nonsymmetrical Airfoils

MANY OF YOU have heard of and some of you are wondering about the cambered airfoil of the CH-47B and C. Of the numerous improvements over the A model, one of the most interesting is a new rotor blade design — specifically the nonsymmetrical cambered airfoil.

One glance easily identifies the new blades from those of the A model and many other helicopters. Gone are the nicely rounded tip covers, the symmetrically shaped cross sections, the straight trailing edge. Instead, we have a blade that has a flat tip cover plate, a wider chord, and, of greatest interest, *a cambered airfoil section* like an airplane wing, *plus a turned up trailing edge.*

Historically the symmetric airfoil section has always been associated with helicopters, and it has been taught that the cambered airfoil section was not feasible for helicopter use. This belief was based on the "center of pressure." Actually the center of pressure is an imaginary point on an airfoil where all aerodynamic forces are considered to be concentrated. Heretofore, the resistance to using a cambered airfoil was based on the fact that the center of pressure "walked" forward or aft as the rotor blade angle of attack changed. For example, the center of pressure would move aft for a small angle of attack and forward as the angle of attack increased.

This migration of the center of pressure is undesirable since its shifting would introduce large and adverse pitch-changing forces into the pitch links and upper flight controls. In a blade of symmetrical design, the center of pressure travel was minimized by airfoil symmetry and was usually located at a point 25 percent of the chord aft of blade leading edge. For all intents and purposes it did not travel with changes in angle of attack and kept the pitch changing forces to a minimum. So the obstacle to overcome before we could use the cambered airfoil was that of eliminating these extremely high control forces.

As helicopter technology developed, an increased understanding of the actual source of rotor control loads demonstrated that they are the result of several phenomena. One of these is the blade section pitching moment characteristic, the effect of which can be nullified by proper blade section design.

NASA and the helicopter industry have been extremely active in blade airfoil testing. Their object has been to define a high lift airfoil section that retained the desirable drag and moment characteristics of the symmetrical airfoil. This is done by building a 3° upward reflex into the trailing edge section of the blade, which provides the desired low moment characteristic. Thus we can obtain the increased lift characteristics of the cambered blade section without the adverse effect on blade pitching moment.

The CH-47B and C departs from the conventional approach and theory of symmetrical airfoils and makes use of cambered airfoil sections in its rotor blade design to take advantage of the 25 percent higher lift capability available with the cambered blade. By using this cambered blade technology on the B and C Chinook, we have provided substantial improvement over the A Chinook performance plus rotor capability margins beyond the performance limits of the helicopter.

Just about one-half of the 50 knot increase in speed is obtained from a 12 percent increase in rotor blade area, and the other 25 knots is picked up from the increased lift capability of the cambered airfoil section. The introduction of this cambered airfoil rotor with its greater lift approximates the addition of a fourth blade to the CH-47A rotor system and is accomplished with but a fraction of the weight increase.

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MAJ WILLIAM W. FRAKER

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THE WINNER'S SHIELD can be yours during this next year if you submit an article for U. S. ARMY AVIATION DIGEST's eighth annual writing contest. Each month the author of the article selected as the best of that issue will receive an engraved plaque and a cash award of $25. From these monthly winners, the three best articles of the year will be chosen. For the best article of the year the award will be $250; the second place award will be $150; and the third place award will be $100.

Manuscripts are eligible for the contest in the month published. To be considered, the article must be an original article about Army aviation or other related subjects under the magazine mission (see inside front cover). Dual authored articles will not be eligible for the contest, but this rule will not prevent their selection for publication.

Articles will be submitted to contest judges in their original unedited form without bylines. These general criteria will be used in selecting winning articles: accuracy, completeness, originality, readability, soundness, substance, and overall merit.

Any pictures, diagrams, or charts available or necessary for illustration should be included with the manuscript. However, such materials will not influence judging of the article for the writing contest.

Send your questions concerning articles or your manuscripts to: Editor, U. S. ARMY AVIATION DIGEST, Fort Rucker, Alabama 36360.